The Electrical Industry's Weekly Magazine March 28, 1960

Electrical World

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Electronic Data Processing

A Special Report on Accounting and Other Applications page 65

Preference Group Submits Report on Colorado Grid . . . page

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seals in oxide-inhibiting PENETROX®
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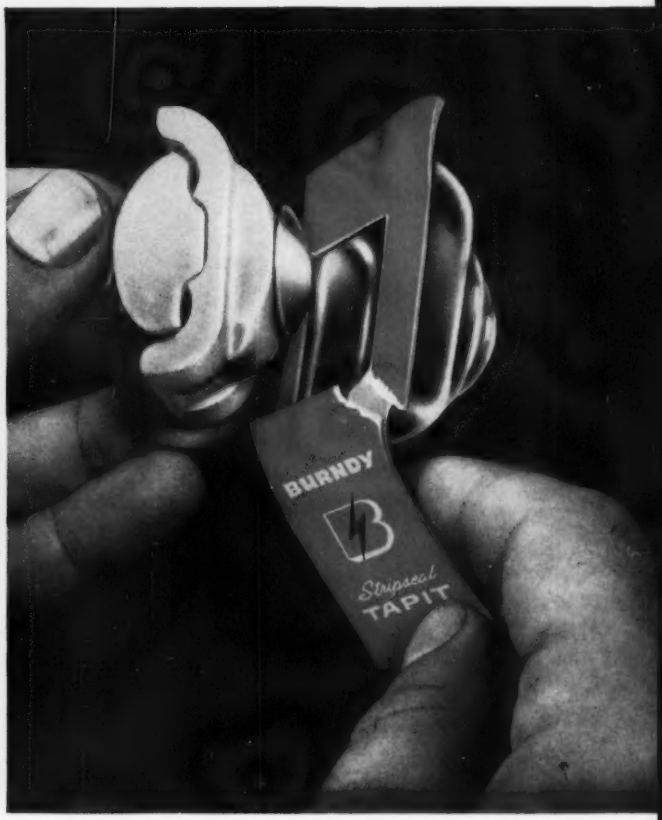

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Electrical World

Vol. 153, No. 13 MARCH 28, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue

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A Value Judgment on Passamaquoddy

Canada's chairman of Joint International Commission says the huge tidal power project is not feasible now.....p 60

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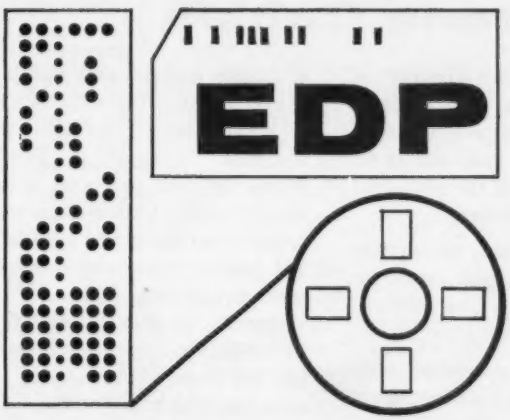
What's the ideal Capital Structure?

Here's how a moderate-sized electric utility might save almost $500,000 on its new financing.....p 115

Special Report



Electronic Data Processing

Special 16-page report presents the first comprehensive study of the impact that the electronic digital computer has made on accounting and other data processing applications in the industry and a glimpse of the future.

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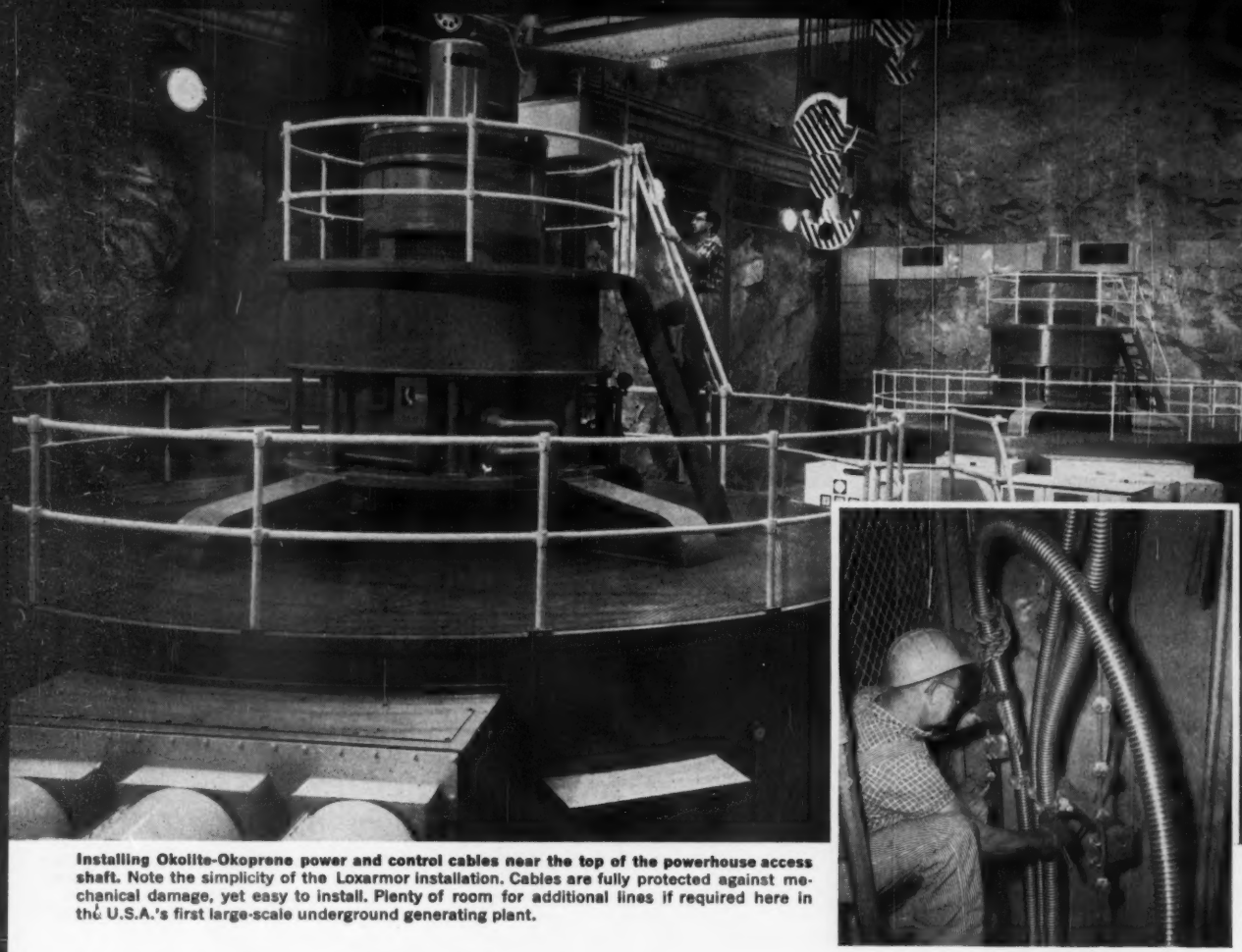

Installing Okolite-Okoprene power and control cables near the top of the powerhouse access shaft. Note the simplicity of the Loxarmor installation. Cables are fully protected against mechanical damage, yet easy to install. Plenty of room for additional lines if required here in the U.S.A.'s first large-scale underground generating plant.

Underground powerhouse uses Okolite-Okoprene Cables

Two-thousand feet inside a granite mountain in California, 500 feet below the surface, are the generators of the new Haas Powerhouse that contribute 128,000 kilowatts to Pacific Gas and Electric's big King's River development.

Leading straight up the 480-foot elevator shaft above the generator room, through the rock to the switchyard atop the mountain ridge, are 10 Okolite-Okoprene Loxarmor-protected cables which handle switchyard control and auxiliary power circuits. Interlocked armor construction provides permanent mechanical protection without the difficult installation problems of conduit and the higher cost of either conduit or "bore hole" suspension.

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When the best can also save you money—as these Okolite-Okoprene Loxarmor cables do in ease of installation and long-term economy—then it deserves serious study.

Send for Okonite Bulletin EW-1090 for full facts on Loxarmor. This economical and flexible covering may be the answer to your cable problem.

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6521

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LETTERS

Takes Issue With Rate Article

To the Editor:

The article, "Utility Rate Structures Need Cost Cushions," (EW, Feb. 15, p 72) by O. S. Vogel discusses escalator clauses applicable to electric rate schedules as a means of cushioning the utility against rapid swings in fuel cost and in "other operating and maintenance costs."

The application in fuel cost escalation is, of course, not new. It has been used for years, and is properly applied to charges for electricity on a kwhr basis, since the consumption of fuel, and thus the cost thereof, varies directly with kwhrs generated and/or sold.

Mr. Vogel, however, does not mention the necessity of reflecting in a true fuel cost escalator the effect of the proportion of hydro generation or purchased power, perhaps because his company has no hydro. In other systems this may be extremely important.

He comments that the escalator really ought to reflect the increased fixed charges attendant upon improved efficiency of the generating plants, and his Exhibit 2 computes how much these amount to on a kwhr basis. This is an incorrect method of application of fixed costs, since it can only result in the application of a correct portion of those costs to a customer or customer group with a load factor precisely the same as that of the system. If efficiency were not to be reflected in the escalator, and the Company were to be compensated for fixed costs incurred to improve it, there might result, during a rate case, a double return on the excess cost of the more efficient generators.

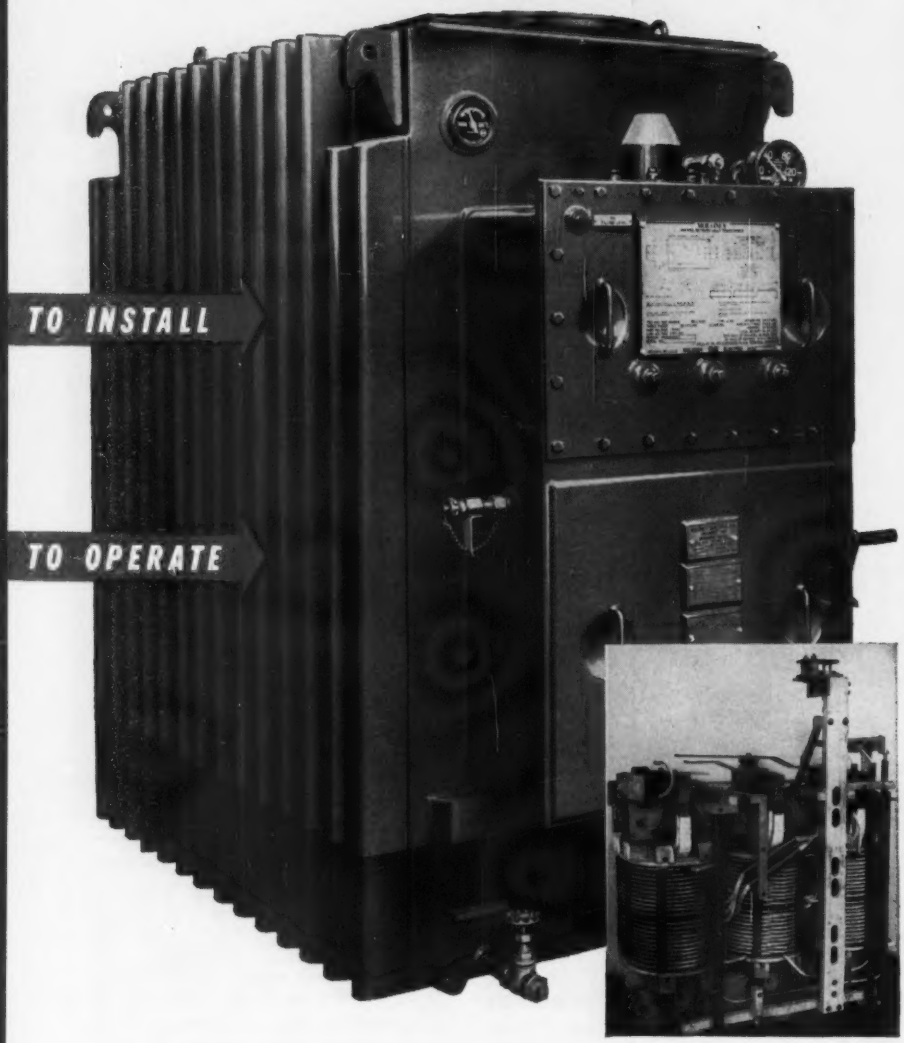
Farther along in the article Mr. Vogel suggests that an adjustment be made because of the increase in operating and maintenance expenses, again computed as a kwhr charge, despite the fact that substantially all of these expenses are fixed in nature. The same criticism of over-assessment of high-load factor users or classes applies to this proposal.

Mr. Vogel points out that either the Index of Commodity Prices of the U. S. Dept of Labor, or the Construction Cost Index of the Commerce Dept can be used for adjustment of operating expenses. In the case of the former, the prices, which go into the index, are not at all related to those things which go into the operation and maintenance of a utility system. Among the items, for example, are the cost of electricity, and the price of Amritsar goat skins!

With respect to the Index of Construction cost, it would only be proper to use such an index to adjust operating and maintenance expenses if the costs, which went into the index precisely reflected the distribution of labor, materials, and supplies as they are used in the utility's expense accounts.

Even if such an index exactly reflected the situation of an individual utility, the adjustment of such fixed costs should be applied to the fixed portion of the charges to customers. It is improperly reflected

ECONOMICAL



BECAUSE:

1. Each tank side completely corrugated out of one piece of metal, requiring welds only at the corners.
2. No thinning of the metal occurs at corrugations.
3. The corrugations do not need sidewall bracing therefore, another possible source of corrosion is eliminated.
4. Tank is easily cleaned from above and there are no inaccessible areas to hinder painting.
5. The tank and handhole covers are welded in place to eliminate the possibility of leaks, however, bolted covers are available if required.
6. Network transformers with corrugated tanks are smaller in size than old style tube type tanks.
7. Reduced size allows installation of larger units in existing vaults.
8. Protection against corrosion is provided by undercoating the base and the lower portion of the tankwall.
9. The core, coil, leads, supporting members and framework are uniquely combined to give ample electrical clearance and to obtain a rugged unit that is exceptionally compact.
10. Low sound level means better customer relations.

Moloney Network Transformers are uniquely designed both inside and out to provide a superior unit for use on secondary network distribution systems. The corrugated tank coupled with a compact, rugged core and coil assembly having high overload capability, offers the potential user many reasons for purchasing Moloney Network Transformers.

These units are available in types conforming to EEI-NEMA Standards or in types especially designed to meet the requirements of your network system.

Specify Moloney Transformers for every application . . .
All Along The Line.

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Button, button—push the button—and up goes the new Holan 2600-A Ladder.

The same fingertip control that made the Holan 2600—which the 2600-A replaces in the Holan line of fine aerial ladders—is present in this new model. The pushbutton control station is on the mast—and a station can be installed on the upper side rail for remote control by the man on the platform.

But a host of important design changes have been made in the 2600-A. A plate metal support frame replaces one of tubular construction; the crank for 360° rotation has been located on the left side, out of the way of the pierced metal, non-skid pedestal steps; and both the dual-level platform and 12,000-volt woodstrain insulators have been made standard equipment on the 2600-A.

The 2600-A is available in heights to 32 feet. Fiberglass covering of side rails and remote pushbutton controls optional.

Holan Corporation, 4100 W. 150th St., Cleveland 35, Ohio
Plants in: Cleveland, Ohio; Griffin, Georgia; Phoenix, Ariz.

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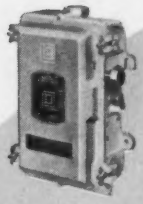
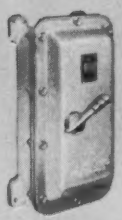
Safety Switches for Normal and Hazardous Locations

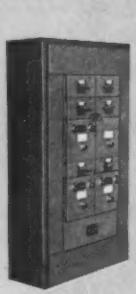


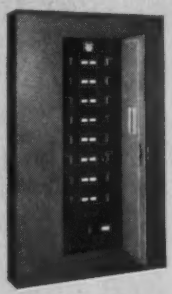


Industrial Circuit Breakers for Normal and Hazardous Locations

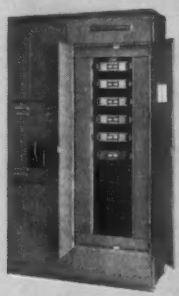
Load Centers—Circuit Breaker and Fusible

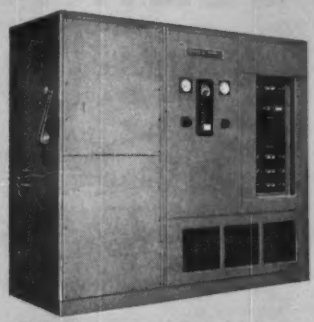
D ...design leadership D ...design l





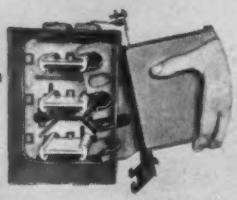
Fusible and Circuit Breaker Lighting and Power Panelboards

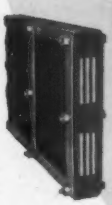




Power Distribution Switchboards and Switchgear

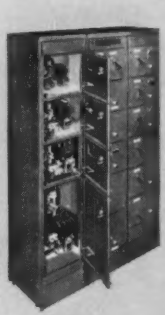
Plug-In Duct

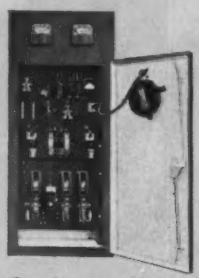




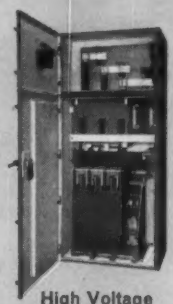
Feed-In Duct

Motor Control Centers





Synchronous Motor Starters



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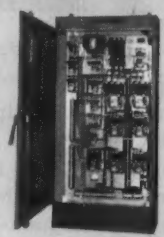

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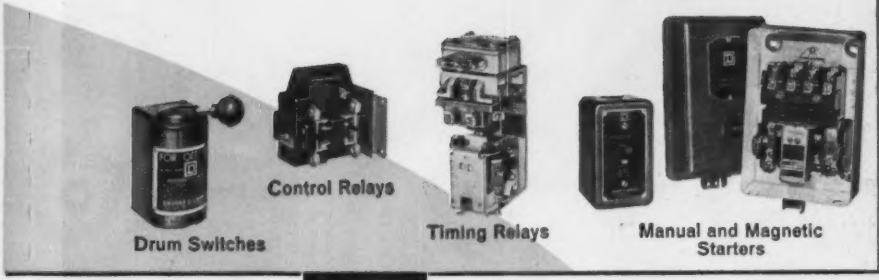

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STAGE DIMMERBOARDS
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SWITCHGEAR & UNIT SUBSTATIONS
SYNCHRONOUS MOTOR CONTROL
TERMINAL BLOCKS
TEXTILE MACHINE CONTROL
TIMERS
VOLTAGE TESTERS
WELDER CONTROL

wherever electricity is distributed and controlled

OPTIC NERVE FOR EYES THAT SEE 100 FEET BELOW THE SURFACE

This is a television camera. Its job is to photograph the substrata of excavations, thereby providing information needed by engineers in planning the construction of Boston's new Prudential Center, a modern, multi-million dollar real estate development.

Here in the Back Bay section of Boston, with its artificially maintained water table, this sealed camera must go down into a water-filled hole 100 feet below the surface. To transmit the picture from the camera to the surface monitor, Lake Service Corp. of Brighton, Massachusetts, designers and manufacturers of the television equipment, chose Simplex Anhydrex XX insulated cable because of its ability to withstand the rigors of submarine and direct burial duty.

For all types of service involving high and low voltages, whether aerial, underground or submarine, or for everyday plant wiring, it pays to call a Simplex Engineer.

Simplex

BALANCED COMPOUNDING

WIRE & CABLE CO.

Cambridge, Mass. • Newington, N. H.

1885 Diamond Jubilee 1960
75 Years of Leadership in the Wire and Cable Industry

The Electrical Week

FUTURE NEWS ▶ **Three southern utilities will announce "Correct and Capitalize" plans** very soon. Under these plans, the companies will help overcome inadequate wiring bottlenecks by capitalizing everything up to the service entrance panel.

LATE NEWS ▶ **The "relative anonymity" of utility research work should end,** Mark W. Cresap, president of Westinghouse, told the Southeastern Electric Exchange meeting last week. Cresap said utilities should claim credit for research carried on for them by manufacturers. He offered his company's help in a "task force approach" to telling the story to the public, to stockholders, and to government.

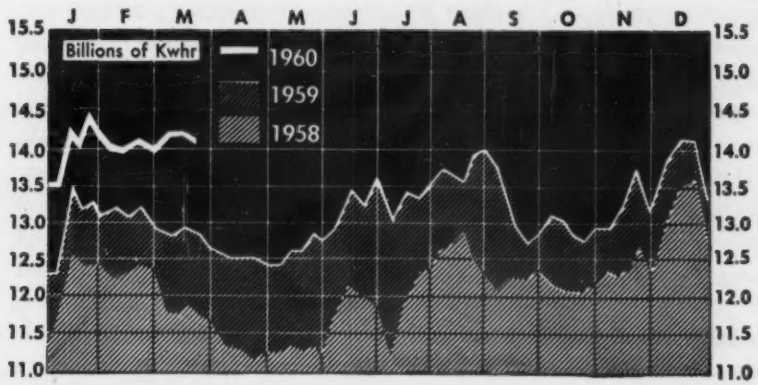
The NEMA Electric House Heating Meeting was a whopping success. More than 2,000 attendees jammed Chicago's Sherman Hotel to hear utility, distributor and contractor speakers extoll heating's promises, and to take in the more than 40 equipment displays.

Washington Wire . . . Bureau of Reclamation asks General Accounting Office to rule on whether high pay scale at Glen Canyon Dam—agreed to by both contractor and union—should be paid by federal government . . . Interior Secy Fred Seaton announces Southeastern Power Administration, celebrating its 10th anniversary, marketed 22 billion kwhr to 134 systems and has received $103,860,000 in revenues during first decade.

IUE Pres James Carey is having labor headaches. His drive to build up momentum for coming contract negotiations with GE have hit snags in the sniping by other unions. The United Electrical Workers have challenged his IUE at GE's Lynn, Mass., plant and the Teamsters have asked for a showdown at Appliance Park in Louisville, Ky.

Management changes . . . W. C. MacInnes, president of Tampa Electric, is elected president of Southeastern Electric Exchange.

WEEKLY POWER OUTPUT—Up 9.4% (Week ending Mar. 19), Kwhr 14,109,000,000



Per Cent Change From Previous Year

	Mar. 5	Mar. 12	Mar. 19
Total U. S.	+10.2	+ 9.8	+ 9.4
New Eng.	+ 5.3	+ 5.6	+ 7.2
Mid. Atlan.	+ 9.2	+ 8.3	+ 9.1
Cent. Ind.	+ 9.0	+ 8.3	+ 7.9
West Cent.	+ 9.4	+ 9.9	+ 8.0
Southeast	+10.5	+12.5	+12.3
South Cent.	+11.0	+10.4	+ 9.5
Rocky Mount.	+15.2	+ 8.8	+10.1
Pacific			
NW	+15.7	+12.7	+ 9.6
SW	+10.5	+10.3	+ 8.1

Seasonally Adjusted Index 274.0

Week Ago 276.6 Year Ago 250.0

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **Differences in transmission plans for Colorado River Storage Project** are displayed for comparison (p 58) . . . U. S.-Canadian Passamaquoddy project receives an important blow in House of Commons (p 60) . . . A new electric automobile is going to market. Henney Kilowatt is its name, SEE is scene of its unveiling (p 61).

SPECIAL REPORT ELECTRONIC DATA PROCESSING ▶ **The uses of electronic data processing for electric utilities** are given comprehensive treatment in this 16-page report. Here are some highlights, with a glimpse of a few things to come:

- What computer equipment for what job? (p 66)
- The first time is always the hardest (p 69)
- Rundown of utility computer experience (p 72)
- Personnel, policies, practices and the computer (p 74)
- The future: everything in one package? (p 80).

ENGINEERING ▶ **How to get savings through spinning reserve** is covered in a piece on a new turbine generator installation aimed at cutting costs while it meets daily peak load (p 63).

PROCUREMENT & PRODUCTS ▶ **University of Illinois sets up fly-ash standards program** for road construction . . . Interior Dept's news that it will hold oil quotas for

Politics and Public Power

TOWARD A HIGH-LEVEL DECISION

A prominent national affairs writer, speaking informally at a recent utility executives' meeting, remarked that any decision affecting the tax deductibility of advertising purported to influence legislation or public opinion, was "important enough to be made at the very highest levels of government." He went on to say that the matter ought not to rest in the hands of a federal administrative agency. Presumably, his reference to "the highest levels of government" was to the Congress or the Supreme Court.

It may be that the first step in getting this high-level decision was taken in May of last year by Rep Hal Boggs (D-La.) when he introduced his bill (HR-7123) to permit the deduction of legislative expenditures for tax purposes.

The second step also was taken by Rep Boggs when he urged support for his bill last month, an action which a number of newspapers and periodicals supported.

In his remarks to the House, entitled "Censorship by Taxation," the Louisiana Democrat stated his reasons for introducing the bill, relating them immediately to the Constitutional aspects of the matter: "To hamper by any means, insidious or unintentional, the open and candid expression of opinion by our people at the forums provided by the Constitution would undermine the Democratic processes by which we remain free. The economic system under which we live today is shaped by political action through legislation . . . Therefore . . . I introduced . . . a bill to amend Section 162, the 'Ordinary and Necessary' business expense section of the Internal Revenue Code of 1954."

the first six months set earlier was music to coal men (p 90) . . . Westinghouse unveils magnetohydrodynamic generators which, using conventional fuel, ran continuously for four minutes and produced 5 kw . . . Allis-Chalmers completes facility for developing underwater fuel-element techniques (p 94) . . . Capacitor equipments in 900-kvar, single-row, pole-type units are now available . . . Pole-top switch needs little maintenance (p 102).

MANAGEMENT ▶ **Is there an "ideal" capital structure for an electric utility?** Probably, but nobody has been able to pin it down—and prove it. We are sure though, that the best mixture of debt and equity tends to push up the market price of the company's common. To find out how a utility might save $500,000 in five years of new financing by following this simple rule, turn to **page 115.**

SELLING ▶ **Hotpoint sees 178-million kitchen-laundry appliances** sold in next 10 years. It also announces plan to simplify service calls (p 123).

NEXT WEEK ▶ **A story on 100,000-kw peaking turbine** to be put in by Long Island Lighting will be featured. Story is bylined by LILCO's engineering vp.

Rep Boggs' bill would amend that section by adding the following:

> Expenses lawfully incurred in supporting or opposing or otherwise influencing legislation in the Congress or in a state's legislature or in the legislative body of a county or other local governmental agencies or in any submission of proposed legislation to the voters, shall be allowed as proper deductions from gross income.

Relating the right of all citizens and groups to communicate lawfully, Boggs said, "If we dilute the right of our citizens to petition for good laws by punitive taxation we deny them the right of self-protection from damaging and destructive legislative action."

The Boggs amendment to the IRS Code is a broad one. It would allow as tax deductible a wide scope of activities not now allowed, such as lobbying expenses. Perhaps it is too wide. But one thing can be said in its favor: It will help to focus public and Congressional attention on a matter which many experts agree requires Constitutional interpretation. In doing so, it will lead to a thorough airing of the matter in the committees and Houses of the Congress. In addition, if it became law, it would probably get a testing in the courts. In short, the whole area of lobbying, and opinion-influencing activities, including their tax status, would be gone into in depth. The result would be a redefining of this area, similar to the redefining of other Constitutional areas which we have had to undertake since the founding of the Republic.

It is difficult to escape the conclusion that clarification would be in the public interest.

Executive Reader

Any persistent long-term shortage of supplies of primary energy in Western Europe is unlikely by 1975. While the need to create new sources of energy is a real one for a much longer period than considered in the study, it does not seem likely that shortages of oil or other supplies will make themselves felt in acute form by 1975. Member countries should not therefore frame their energy policies on the assumption of a probable energy "gap" in European energy supplies, in the sense that insufficient energy would be available at the source. This is one of 24 conclusions drawn in a new study of Western European energy demands and supplies. **Toward a New Energy Pattern in Europe, by The Energy Advisory Commission, Prof Austin Robinson, Chairman, Organization for European Economic Co-operation.**

Inaccuracy, misrepresentation and distortion of the truth in ECAP ads should be met directly by the Federal Trade Commission. It should neither brush it aside as part of "that public-private power fight" nor treat it as an infringement on "freedom of advertising." The sole issue being raised is that of untruthful misrepresentation in advertising. **APPA Asks Probe of Company Ads, Public Power, March, 1960.**

The story of the Rural Electrification Administration's first 25 years was written in response to requests from rural electric cooperatives for a concise history of the program for use in employee and consumer information and educational programs. It should also prove useful to students, librarians, businessmen and researchers, at home and abroad, who want information about the development of rural electrification. It will also prove of value to people in communications media who are interested in facts about REA's program. It is hoped the story will help young people in rural communities to recognize the value of the systems they inherit and to direct their future with wisdom. From the forward by David A. Hamil, REA Administrator, to "Rural Lines, USA," a 68-page publication which tells in 20 chapters, from "The Dark Land" to "Test of the Future," the story of REA's electric loan program. **Miscellaneous Publication No. 811, Information Services Division, REA, U. S. Dept of Agriculture, Washington 25, D. C.** (Single copies on request; also available from Superintendent of Documents, U. S. Govt Printing Office, Washington 25, D. C., 50 cents each.)

Review of the relationship of employment costs to inflation in America compels the conclusion that this nation cannot prudently accept endless employment cost increases that outstrip increases in national productivity. The long term gain in efficiency for the nation as a whole, averaging 2 to 2½% per year, is the only rate of increase which has any relevancy in judging whether any wage increase, wherever initiated, will find an ultimate expression in an elevation of general prices. **U. S. Steel Attacks Wage Inflation, Steel, March 21, 1960.**

Don't Splice It...Loop It

When Cooline L-W clamps are used on distribution deadends, trouble-free jumper loops can be formed quickly, efficiently without cutting or splicing the conductor.

Low-cost Cooline L-W clamps offer many of the advantages of heavy duty Cooline clamps for transmission lines, but are especially designed for the distribution and sub-transmission trend toward larger conductors and shorter spans.

The L-W clamp has a powerful snubbing action which has high holding power without crushing the conductor. The six models in the series cover a range from .2 to 1.3 inches in conductor diameter with more than adequate ultimate strengths.

Installation is simple since no special tools or skills are required. A few minutes with a standard wrench and Cooline L-W clamps are ready to serve the life of the line.

Just look at these many advantages: design that permits the use of continuous jumper loop without splicing conductor . . . convenience . . . high, maintained holding power . . . low installed cost. And the aluminum construction minimizes electrical losses and conductor heating.

It's certainly worth your time to investigate the many advantages of Cooline L-W clamps now.

Distributed by GraybaR ELECTRIC COMPANY

OHIO BRASS COMPANY, MANSFIELD, OHIO

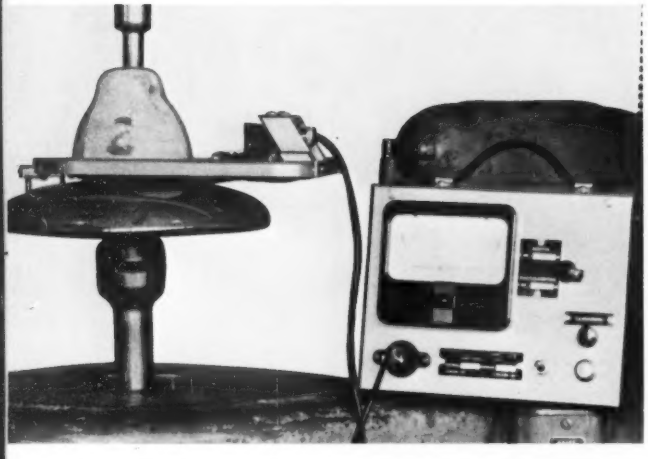
Ohio Brass

HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

O-B FUTURA

So radically improved we had to create new tools to design it . . . test it . . . produce it!



New Design Tools

Precisely what happens to the porcelain barrier between cap and pin when a suspension insulator is under mechanical load?

O-B engineers were the first to know, the first to actually measure - - in millionths of an inch - - how porcelain responded to the radial pressures exerted by the insulator pin. The picture at left shows a gaging instrument and transducer recording porcelain deflection on a completely assembled insulator under tensile load.

The precise knowledge gained from this new tool helped O-B engineers produce the improved porcelain shape of the strongest and most efficient insulator, pound for pound, ever made - - Futura!

New Test Tools

As reported in a recent technical paper (available on request), O-B engineers were the first to devise an accurate method of measuring the lightning puncture strength of high voltage insulators.

The test set-up shown at the left permits the application - - and accurate measurement - - of voltage rates of rise up to 6,000,000 volts per 1/1,000,000th of a second. (Actually, this impulse is so fast that it's "come and gone" before the electrical signal can reach the recording equipment!)

As a result of new tools like this one, the Futura insulator resists a 60 per cent steeper impulse wave than its predecessor!

SUSPENSION INSULATORS with CIS*

*Corrosion Interception Sleeve

Above — Section of Futura Porcelain

New Production Tools

In O-B's new mile-and-a-quarter long mechanized production line are many new tools which help to achieve a higher degree of accuracy . . . uniformity . . . control . . . than was possible before.

This modern equipment assures that the inherent superiority of the Futura design will be faithfully reproduced in every insulator that leaves the production line.

Shown below is a close-up view of the hot-press forming operation which molds the top surface of Futura's new porcelain shape.

A New Insulator!

New design tools, new test tools, new production tools have thus created Futura - - the industry's first new suspension insulator in decades.

Just as important as Futura's extra margin of mechanical and electrical strength, however, is the built-in protection it provides against corrosion damage - - damage which might otherwise destroy this greater strength in the years ahead.

Futura's unique Corrosion Intercepting Sleeve (C.I.S.) has been proved in 15 years of service (to date) in contaminated atmospheres which caused other insulators to fail in as little as four years.

No other suspension insulator protects itself, protects the user, like Futura - - best buy on today's market - - for today *and* tomorrow!

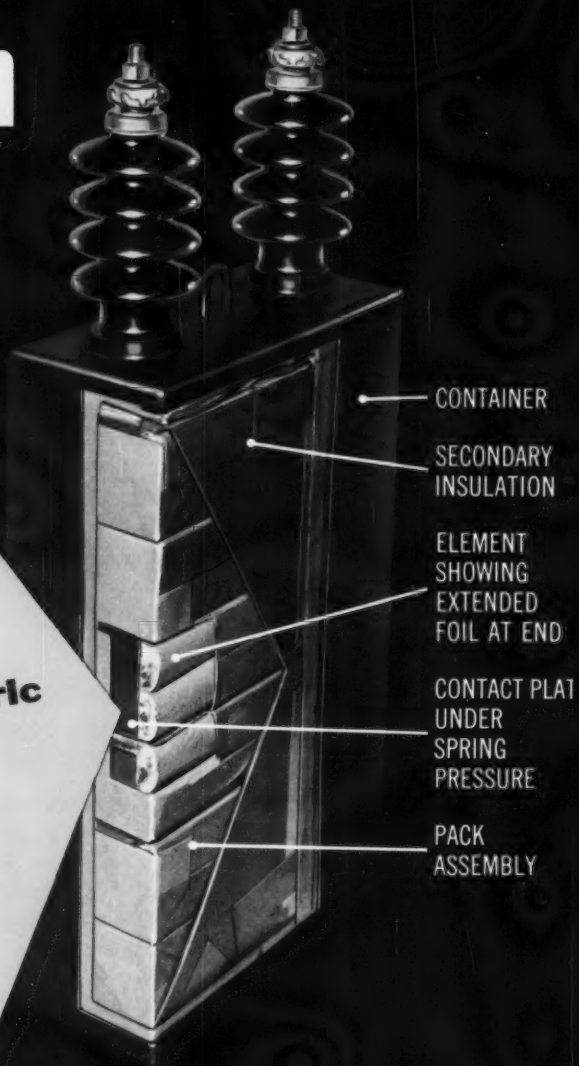
OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10025-H

Exclusive with VAREX®



contacts are made outside the active dielectric under strong spring pressure

Varex is the *only* capacitor whose elements are totally free of mechanical insertions in the active dielectric!

Varex engineers have eliminated these mechanical insertions, or tabs, from the dielectric by means of the exclusive "extended foil" design. As shown above, every turn of foil extends beyond the paper dielectric and makes a broad contact with a plate under strong spring pressure.

This exclusive Varex design has thus removed a possible source of mechanical damage during winding, and a cause of higher electrical stress in the adjacent paper dielectric.

This means lower current density, cooler operation, and appreciably longer life for Varex capacitors!

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

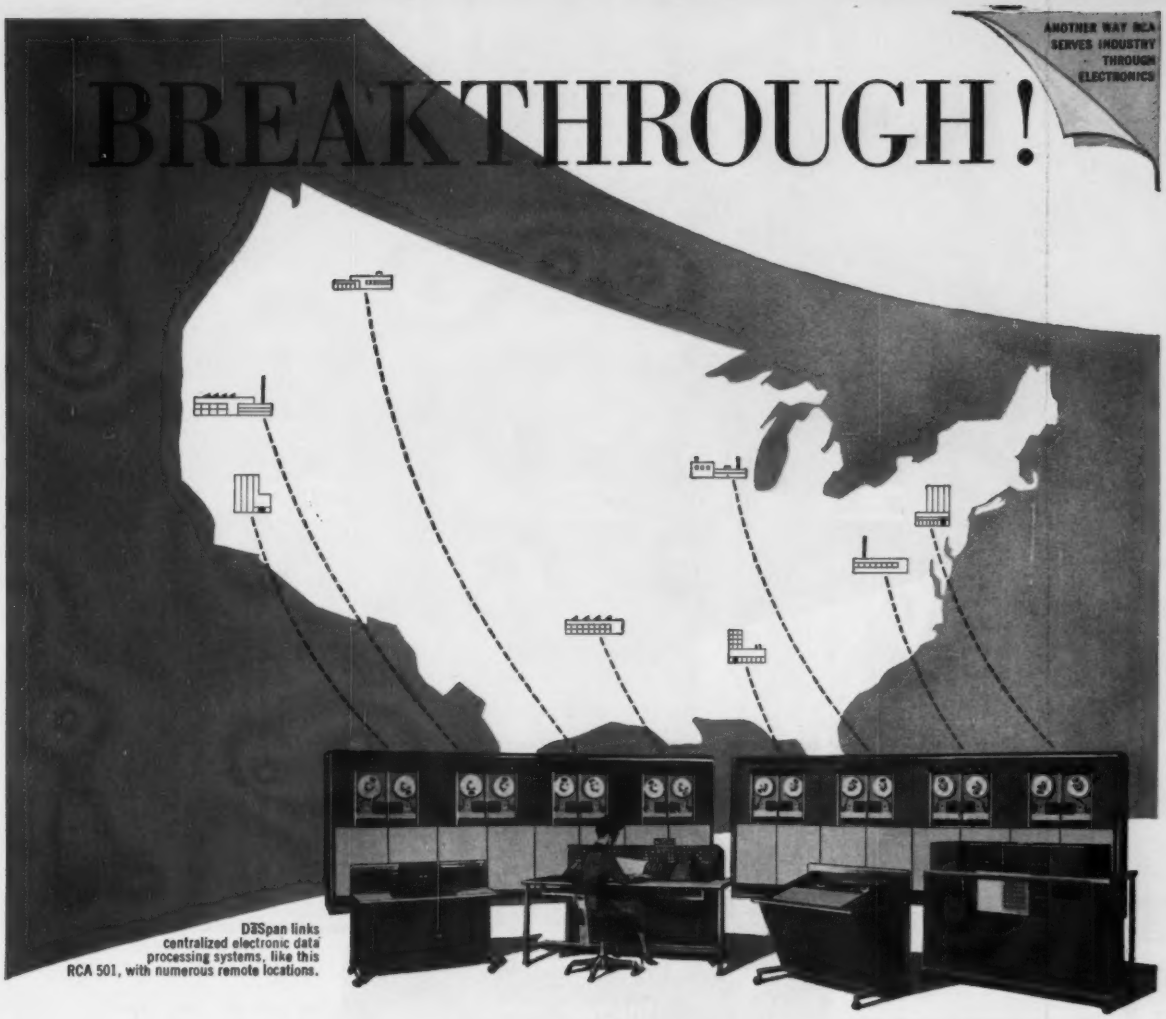
HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10025-H

ANOTHER WAY RCA SERVES INDUSTRY THROUGH ELECTRONICS

BREAKTHROUGH!



DāSpan links centralized electronic data processing systems, like this RCA 501, with numerous remote locations.

RCA DāSpan...a new digital data communications system for computers, combining low cost, speed, versatility and accuracy

New RCA Communications System for electronic data processing scores major breakthrough in low cost data automation. Provides tighter management control and better customer service.

The world leader in electronic communications, RCA, has engineered a long-sought step forward in EDP-oriented, high-speed communications. New DāSpan transmits and receives digital information over telephone lines . . . providing truly integrated data automation, even when coast-to-coast distances separate your computer location from your warehouses, factories or sales offices.

Because telephone lines are employed, on a toll-call or lease basis, DāSpan can serve all your automation and EDP needs at high speed and with great economy. Where communications of slower speeds will suffice, RCA DāSpan can also be supplied for use on telegraph lines. DāSpan, whether by telephone or telegraph lines, has built-in accuracy control features necessary to the data processing operation.

DāSpan is the ideal solution to the problem of scattered facilities, to management's need for up-to-the-minute facts and to coordinating multiple EDP installations at low cost. In fact, wherever industry depends for its future on better control, on improved customer service and on last-minute information from every part of an operation, RCA DāSpan will open new avenues to profits and smoother functioning.

For information, write:

RADIO CORPORATION of AMERICA

ELECTRONIC DATA PROCESSING DIVISION • CAMDEN 2, NEW JERSEY

Tmk(s)●

All necessary crimping information is clearly printed on splice barrel
1
"Third Hand" Tool holds both cable ends inside splice, freeing both hands for crimping
2
Light weight UTILI-SPLICER Hand Tool imparts the exact crimp each time
3

SIMPLICITY!

Now, the AMP Step-Down UTILI-SPLICE, combined with the new light weight crimping tool and the "Third Hand" Tool, give you still greater economies in your step down splices, savings in man-hours plus AMP's reliable attachment method. For all stranded, solid or ACSR conductor combinations in copper and/or aluminum . . . wire size range #8 through #1/0 AWG.

Send for more information today.

CHECK OFF THESE ADDITIONAL HIGHLIGHTS:

- **long-life corrosion resistance from special tin plating and from inhibitor-sealing compound that pre-cleans contact surfaces**
- **splice lengths proportioned to the cross section of cable**
- **optimum heat dissipation**
- **wire-stops assure proper insertion depth of stripped cable**
- **maintenance free**

American Pamcor, Inc.

GENERAL OFFICES: 181 HILLCREST AVE., HAVERTOWN, PA.

Exclusive Distributor For AMP Products To The Utility Industry

- Only One Tank to Lower
- Easy Access to all Internal Parts
- From 30 to 80 Gallons Less Oil
- Saves 20% Maintenance Time

NEW I-T-E TREND-LINE BREAKERS SET THE PACE FOR SUBSTATION ECONOMIES

I-T-E, the foremost U.S. manufacturer of switchgear and power interruption equipment, announces an exciting new line of outdoor power circuit breakers—the I-T-E TREND-LINE. Now, substations may employ single-tank breakers in subtransmission ratings with complete confidence in the reliability and performance.

Incorporating a new KOOL-ARC vertical interrupter, these breakers deliver 5-cycle interrupting time as standard performance. Although all phases are contained within a single steel tank, adequate clearance and special tank liners and phase barriers ensure equal or better protection than that afforded by three-tank designs. The new single tank can be easily dropped by one man using an electric tank lifter. With only one tank to service and maintain, substation economies are realized that were previously impossible with the old three-tank designs.

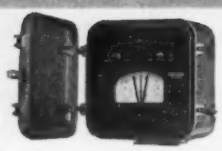
For descriptive literature on the I-T-E TREND-LINE, write to 1667 North Main Street, Los Angeles 12, Calif., Dept. EWO-960-1.

I-T-E CIRCUIT BREAKER COMPANY
KELMAN POWER CIRCUIT BREAKER DIVISION

achieve optimum system performance

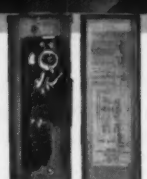
with SANGAMO

Socket type voltage Lincolntrol

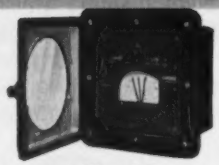


Voltage Lincolntrol with thermostat bias

Carryover socket type time switch



Carryover type time switch



Switchboard type Lincolntrol

STATEMENT:

Installed in greater numbers every year, power capacitors are enabling many electric systems to approach unity power factor at peak load. However, capacitors installed in excess of light load kvar requirements must be switched to obtain optimum performance with maximum benefits.

PROBLEM:

System kvar loading and its effect on system operation varies widely during the daily load cycle . . . from day to day, from season to season, from feeder to feeder. Application of capacitor kvar in excess of circuit kvar loading can result in overvoltage, increased losses, and generator instability. Hence, capacitors installed in excess of light load kvar requirements must be switched to obtain optimum performance with maximum benefits.

Sangamo Lincolntrols measure an electrical quantity (volts, amperes, kilowatts, kilovars) and, as a function of that quantity, initiate operation of capacitor switches. The signal relay element is a time-proven Lincoln thermal meter . . . simple, rugged, accurate. Its inherent time-lag characteristic is ideally suited to capacitor switching.

Lincolntrols include all the customary accessories . . . fuse, manual switches, counter. They are supplied in strong, durable and weatherproof cast aluminum enclosures for socket or conduit connection, or in indoor construction for conventional bottom connection or switchboard mounting.

AUTOMATIC CAPACITOR CONTROLS

SOLUTION:

Specify Sangamo Capacitor Controls—whether you automatically switch capacitors as a function of voltage, current, watts, vars, temperature, time, a combination of these, or in sequence, there's a Sangamo control to do the job . . . the most complete line of capacitor controls in the industry.

Sangamo Time Switches provide automatic capacitor switching on predetermined time schedules. Relatively low in cost, they are the service-proved time switches with holiday cutout and automatic carryover (that keeps them running during power interruptions for as long as 10 hours). Time switches, in combination with other controls, have been perfected to best meet certain application requirements.

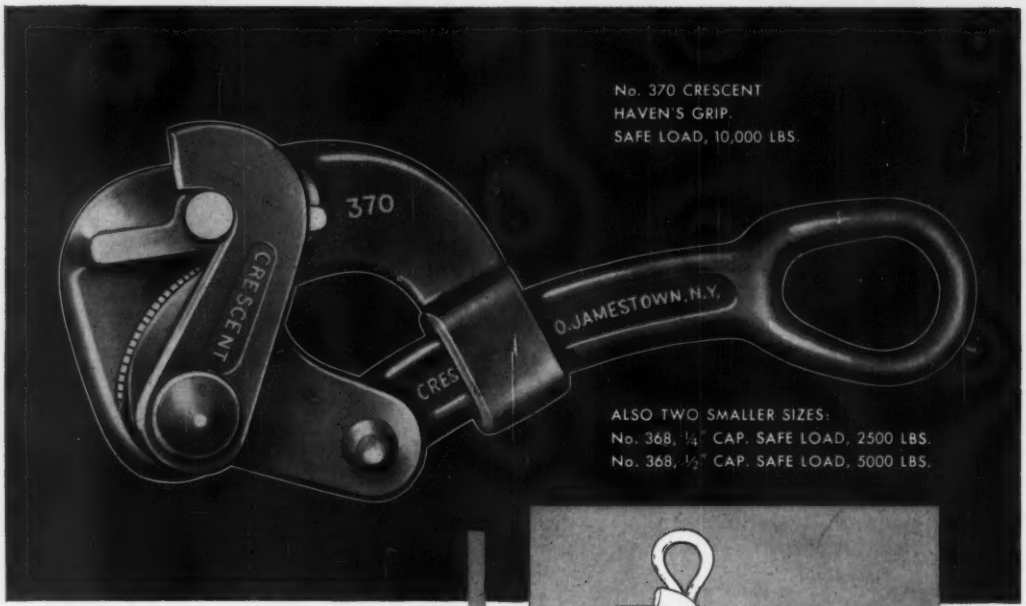
PC60-2

SANGAMO ELECTRIC Company

SPRINGFIELD, ILLINOIS

KEEP PACE ELECTRICALLY

Here's a NEW LARGE CAPACITY CRESCENT HAVEN'S GRIP



● No. 370 Haven's Grip has been added to the Crescent line in answer to insistent demand for greater capacity in these proven grips. Its capacity of 9/32" (.282) to 13/16" (.8125) will accommodate many sizes and types of wire.

Note that this grip incorporates a safety latch which not only prevents it from falling off the wire, but adds greatly to its structural strength. Like all Crescent Grips, No. 370 is forged from special alloy steel, carefully heat treated and finished in Cadmium plate.

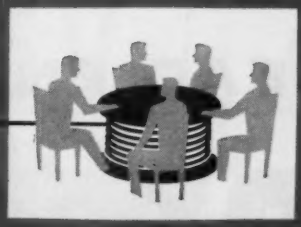
Parallel jaws assure a positive grip that will not injure wire. Jam-proof, instant releasing. Four sizes, with either smooth or serrated jaws, 5/16" to 1-1/16" capacity — up to 12,000 lb. safe load.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

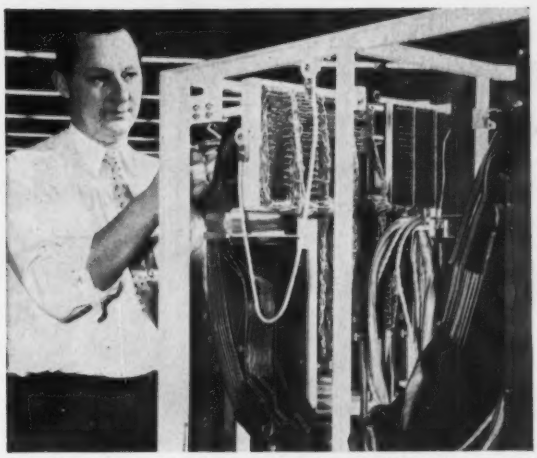
CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

DU PONT

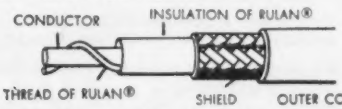
WIRE AND CABLE ROUND TABLE



Flame-retardant insulation of RULAN® used by IBM has five outstanding qualities



Approximately 1000 feet of cable are installed in each new IBM 7090 computer. Only the most dependable of insulating materials could meet the rigid requirements.



The unique design consists of a thread of RULAN spiraled around the conductor to provide for an air space between the conductor and insulation.

IBM's new 7090 fully transistorized data-processing system is the most powerful system to be marketed commercially. It has computing speeds more than six times faster than previous systems...can read and write 3,000,000 bits of information a second.

AN air-spaced ribbon cable, insulated with Du Pont RULAN flame-retardant plastic, is used in the new 7090 Data Processing System, manufactured at the huge IBM plant in Poughkeepsie, N. Y. Performing such feats as reading and writing three million units of information a second, the 7090 relies heavily upon its electrical system. IBM selected a dependable cable insulated with RULAN, developed and manufactured by William Brand—Rex Division of American Enka Corporation, Concord, Massachusetts.

The most important consideration is the flame retardance of the insulation of RULAN. The possibility of fire in such an important and expensive machine, although slight, is not worth risking. Thus this insulation, with an excellent self-extinguishing capacity, proved acceptable. RULAN was also chosen because it has a low dielectric constant over a wide frequency range. Its excellent dielectric properties give RULAN still another useful quality—it can be thinner than many other materials.

Because the installation required that the cable bend around corners, it had to be flexible and have a good radius of bend. Again RULAN proved wholly acceptable. With approximately 1000 feet of cable installed in each machine, cost is an important consideration. And RULAN proved to be lower in cost than other suitable materials with the same properties.

You may find one of the Du Pont plastics will help you solve your wire and cable problems. Find out how by writing to your wire and cable supplier, or to: E. I. du Pont de Nemours & Co. (Inc.), Dept. M-328, Room 2507A Nemours Building, Wilmington 98, Delaware.

Du Pont does not manufacture wire and cable, but supplies thermoplastic resins for insulation and jacketing.

POLYCHEMICALS DEPARTMENT

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING...*THROUGH CHEMISTRY*

ALATHON® POLYETHYLENE RESINS | **RULAN®** FLAME-RETARDANT PLASTICS | **ZYTEL®** NYLON RESINS

DEAD END WITH

BLACKBURN

W6-2A from 6 Sol to 2 ACSR
This Clamp Will Handle All
Popular Service Drop Wires

WEDGE CLAMPS

For Light Service
W6-4A
6 Sol to 4 ACSR

For Heavy Service
W2-OA
2 Sol to 1/0 ACSR

Conductor in contact with wedge for entire length of slider.

Removable aluminum slider allows installation without threading through clamp.

Drop wire can be pre-sagged and cut to exact length needed.

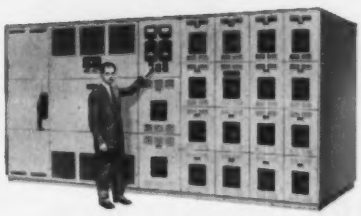
Can be attached to bare neutral at any point in the span.

Your Choice of 3 Bails

STANDARD FLEXIBLE CAPTURED FLEXIBLE FREE

JASPER BLACKBURN CORPORATION 1525 Woodson Rd., St. Louis 14, Mo., WYdown 3-9430.

"But I was positive we didn't need another substation!"



MORAL: For good voltage regulation and better operating efficiency, put a secondary unit substation in each load area. And for complete information on today's most value-packed line of substations, write for Bulletin 3104-1A, I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton Street, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

GROW FAST
WITH Cavalier ELECTRIC HEAT

Ride the tide of popular demand for Cavalier automatic electric heat.

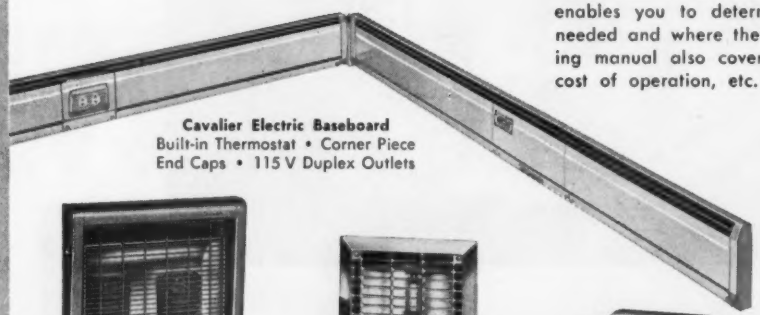
Most often, Cavalier electric heat is the ideal installation for new homes or old, offering more flexibility in planning, more comfort for the user. Cavalier heat is the simplest ever devised, is easily installed and guarantees years of trouble-free service. You'll find it easy to promote.

A wealth of engineering and merchandising service is available at Cavalier. If you would like help in getting your share of this important and fast growing market, just let us know.

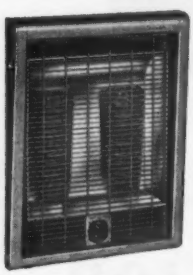
Merchandising help — National advertising is backed by folders, inserts, ad-mats, posters, displays, trade shows, radio and TV spots and the whole range of promotional activities to help you **GROW** with **CAVALIER.**

Cavalier . . . THE COMPLETE LINE

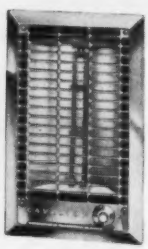
GUIDE FOR CALCULATIONS OF ELECTRIC SPACE HEATING enables you to determine what Cavalier units are needed and where they should be placed. This working manual also covers loss, insulation requirements, cost of operation, etc.



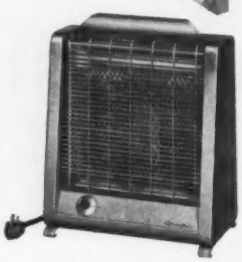
Cavalier Electric Baseboard
Built-in Thermostat • Corner Piece
End Caps • 115 V Duplex Outlets



Cavalier Wall Insert
1 to 5 KW



Cavalier Bathroom
Automatic and non-automatic
120 and 240 volt



Cavalier Portable
2, 3, 4 KW

Cavalier
Radiant Cable

HIGHEST QUALITY Electric Heating Equipment sold only through trade channels to safeguard the consumer, the contractor and the distributor.

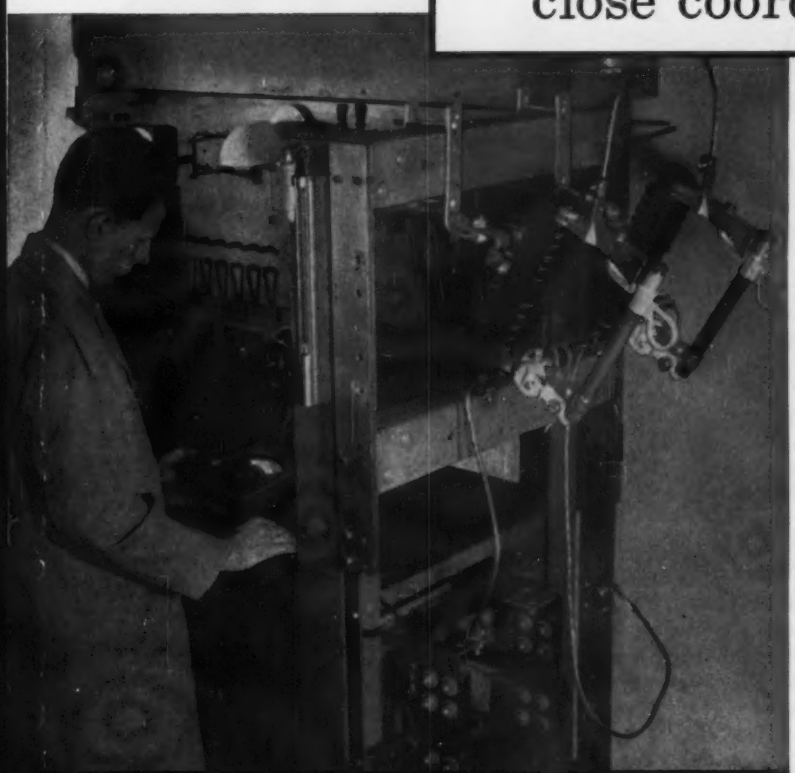
ELECTRIC HEATING DIVISION **CAVALIER CORPORATION** CHATTANOOGA 2, TENNESSEE

OUR 95th YEAR OF QUALITY PRODUCTS

FIRST *in quality construction*
in engineering advances
in safety
in sales making features

It takes KEARNEY QUALITY in Fuse Links

to give you positive protection . . . close coordination



Controlled manufacture and rigorous testing provide maximum service continuity

Quality control in KEARNEY Fuse Links starts with design . . . and continues through careful selection of materials, precision parts manufacture, expert assembly and strictest inspection and testing. The end result is dependable protection . . . uniformity that guarantees all Fuse Links of the same rating will perform exactly alike.

ALL KEARNEY Fuse Links feature low temperature operation. Pure tin elements or low melting point solder, selected for proper strength and melting temperature for each current rating, keep temperatures inside the cutout tube well below charring point. This provides accurate, positive arc clearance even after long periods of overload.

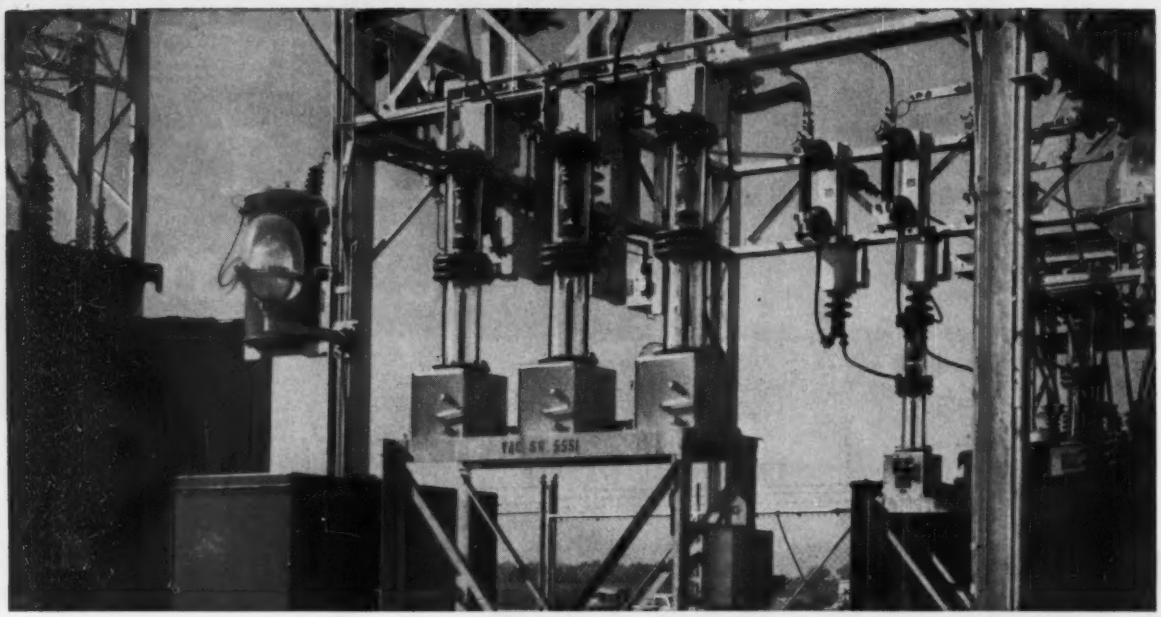
Take care of your requirements in Specialized and Standard Fuse Links with KEARNEY. Contact your KEARNEY Representative.

JAMES R. KEARNEY CORPORATION • 4224-42 Clayton Avenue • St. Louis 10, Mo.

FOR BETTER CONSTRUCTION—SAFER MAINTENANCE

Specify Kearney Products

Plants at: ST. LOUIS • FAYETTEVILLE, ARKANSAS • SHENANDOAH & CLARINDA, IOWA • GUELPH, ONTARIO, CANADA



12 kv circuit breaker specified by International Steel Mills Equip. Corp., San Jose, Calif. for installation on Salt River Project System, Tempe, Arizona

Sensational New *Vacuum Power Switches* offer Long Life... *Maintenance Free!*

Exceptionally long life and elimination of maintenance were major considerations affecting the decision of International Steel Mill engineers to select Jennings vacuum power switches to control and protect their new 5000 and 2500 kva arc furnace transformers.

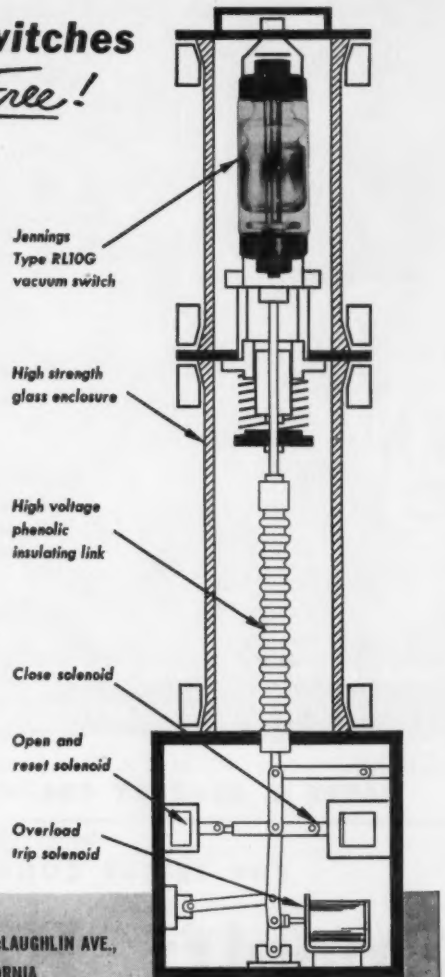
Jennings vacuum switches are able to provide long life because the combination of tungsten contacts plus a vacuum dielectric minimizes arc erosion which eliminates the problem of contact maintenance common to other high voltage switching devices. International Steel Mill engineers report contact life of 20,000 operations in a similar application.

The complete circuit breaker as supplied to International Steel Mills has been shown in the line diagram at the right to illustrate another inherent advantage of high vacuum switches. Their extremely high dielectric strength allows switchgear design with minute contact openings of only 5/32 inch permitting small, light-weight actuating mechanisms. Depending on requirements, fault current interruption can be accomplished within 1/2 to 2 cycles after the fault is initiated.

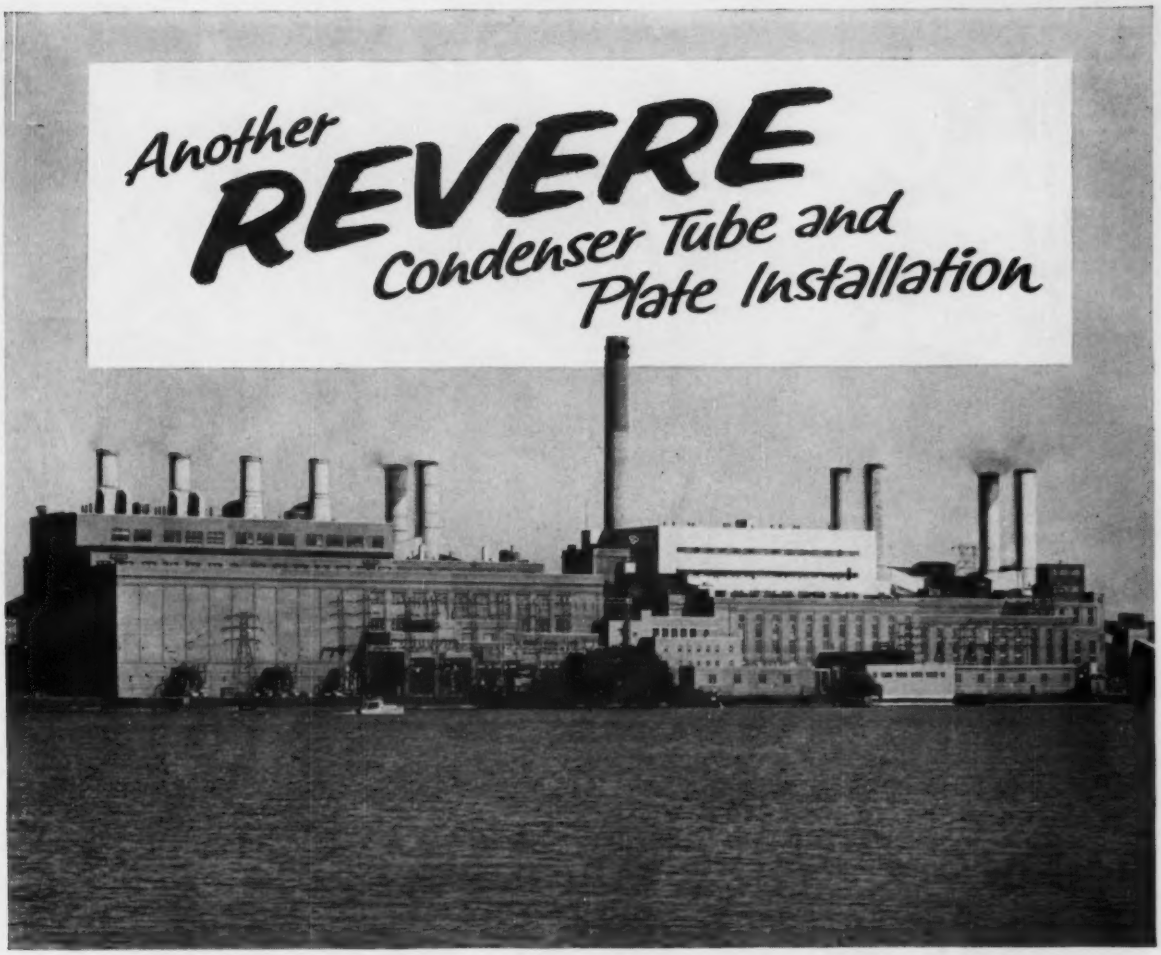
Vacuum power switches have proven particularly successful in applications involving capacitor switching, fault current interruption, transmission line dropping and load break switching.

Our distribution of vacuum switches is through switchgear manufacturers who design and build complete switchgear equipment, utilizing Jennings vacuum switches.

Free Power Switch Catalog contains complete data on Vacuum Switch Properties and our ten sizes of Power Switches.



Jennings RADIO MANUFACTURING CORPORATION • 970 McLAUGHLIN AVE., P. O. BOX 1278 • SAN JOSE 8, CALIFORNIA



Another Dependable Worthington Condenser for

NIAGARA MOHAWK POWER CORPORATION

(Unit #67 Huntley Steam Station, Buffalo, N. Y.)

The 95,000 sq. ft. Worthington Surface Condenser is equipped with 196,000 pounds of Revere Admiralty Condenser Tubes, and 29,000 pounds of 1½" thick Revere Muntz Metal tube sheets.

These particular metals were selected by the manufacturer because they best fit the specific operating conditions that will be encountered in this particular installation. Other operating conditions and requirements call for other alloys.

It is this careful selection of the "metal to fit the job" that has built, for Revere, a reputation for dependable condenser tube and plate performance under all kinds of operating conditions.

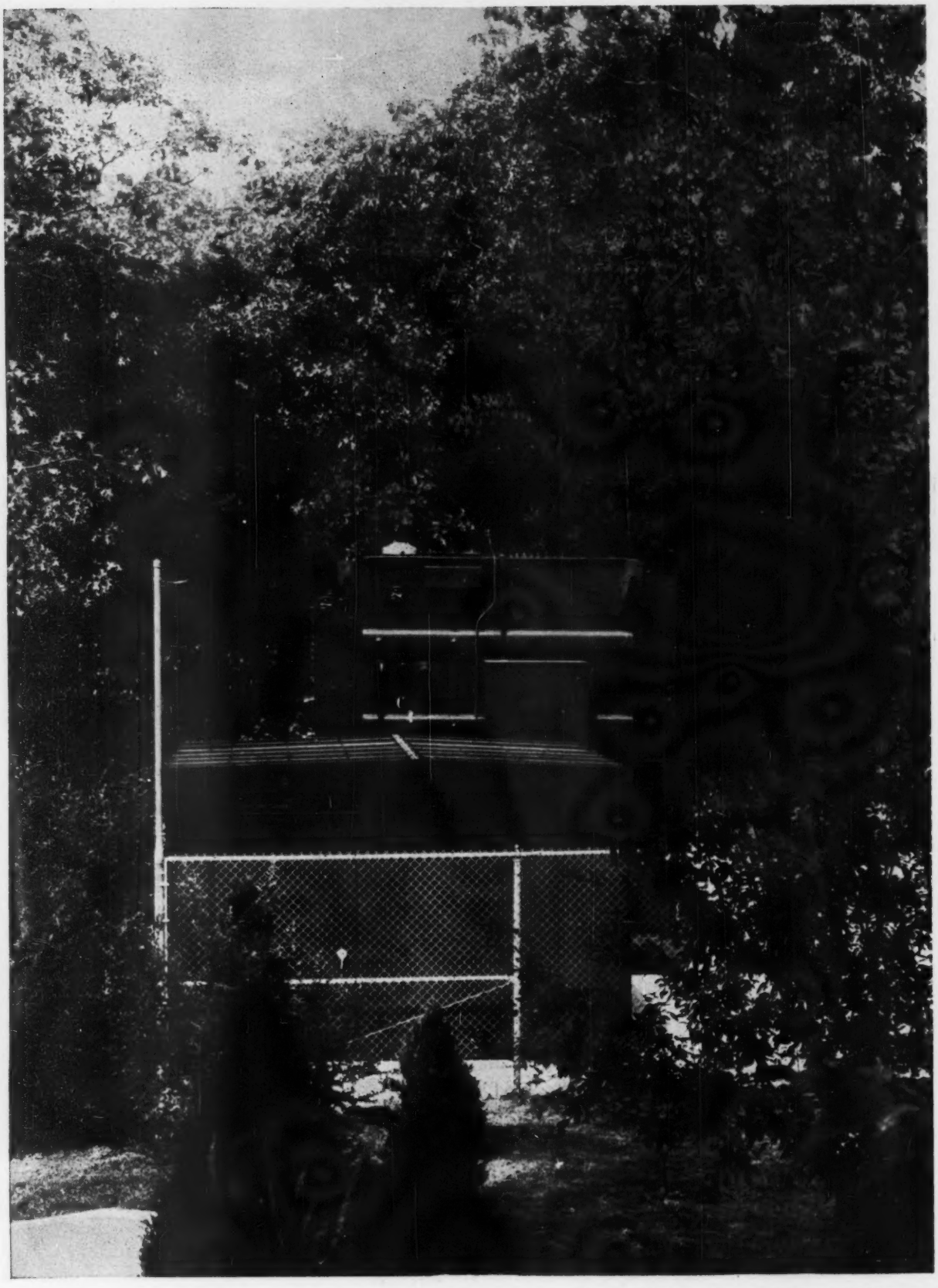
Over the years Revere's Research Department has compiled extensive data regarding the relative corrosion resistance of the different alloys under a wide variety of operating conditions. Why not take advantage of this storehouse of facts and consult with Revere's Technical Advisory Service before selecting the tubes and plates for your equipment?

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

INTEGRAL FINNED TUBE • BIMETAL TUBE • INSTRUMENTATION TUBE • CONDENSER TUBES IN CUPRO-NICKEL, ALUMINUM BRASS, ADMIRALTY, HERCULOY, ARSENICAL COPPER, MUNTZ METAL AND OTHER ALLOYS. ALUMINUM TUBE, SHEET AND EXTRUSIONS. SMALL AND LARGE PLATES IN CUPRO-NICKEL, COPPER, HERCULOY, MUNTZ METAL, NAVAL BRASS AND ADMIRALTY.



HIDE YOUR SYSTEM GROWING PAINS WITH QUIET, ATTRACTIVE SHELTERFOR-M* UNIT SUBSTATION

System load growth demanding new substations on your system? Utilities throughout the country are finding a simple solution to the problem *usually* faced with expansion plans. Westinghouse can relieve you of the time-consuming engineering and purchasing details for your next substation.

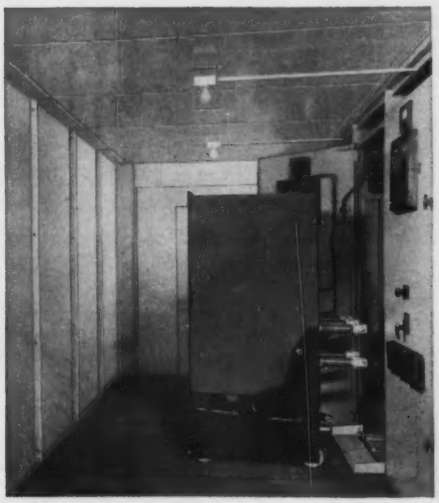
One set of specifications, one source for all your equipment, one contact source to iron out all the details. Westinghouse designs and manufactures all the components of the unit substation . . . carefully coordinated and engineered to work together . . . complete and ready to install.

SHELTERFOR-M GIVES ALL-WEATHER MAINTENANCE PROTECTION IN ATTRACTIVE SUBSTATION DESIGN

Westinghouse Shelterfor-M† metal-clad switchgear provides a protected operating and drawout aisle. Compact design trims site requirements . . . eliminates expensive concrete service and drawout pads. Clean, compact and modern structural lines of the coordinated switchgear and transformer sections make this Westinghouse Shelterfor-M unit substation a better neighbor in residential installations.

WESTINGHOUSE SUBSTATION TRANSFORMER HELPS MAKE THIS UNIT SUB A GOOD NEIGHBOR

Extensive research in the Sharon anechoic chamber has produced substation transformers having new low sound levels. Designed for crowded installations in the bustling suburbs, these transformers are trim and uncluttered. Ask about the extra value in Westinghouse pressure-ring design of coil support and Hipersil® cores.



For complete facts on the Shelterfor-M unit substation, just call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-60980

*Shelter-for-Maintenance †Trade-Mark

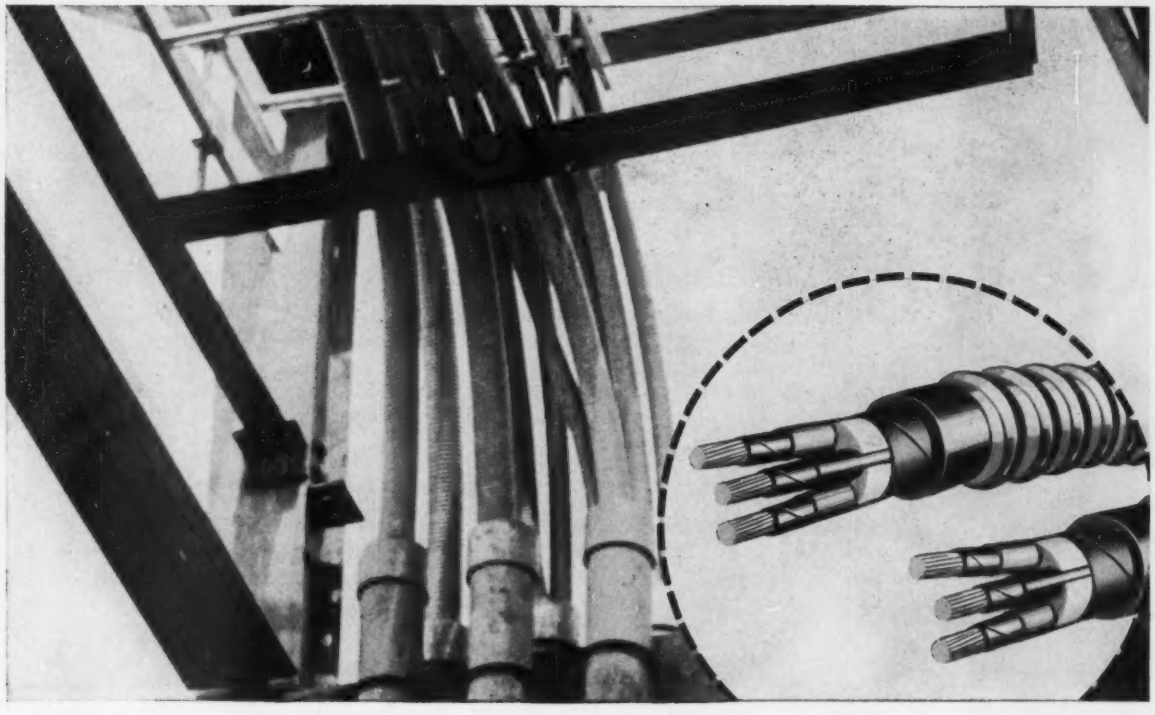
SHELTERFOR-M AISLE—
provides ample space for breaker inspection, interchange and other maintenance work—regardless of weather conditions.

YOU CAN BE SURE...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV ALTERNATE FRIDAYS

Goodyear uses
NATIONAL ELECTRIC NEPCO-LOK in plants around the world



Thousands upon thousands of feet of Nepco-Lok Interlocked Armored Cable are installed in Goodyear plants from the Philippines to Scotland. Typical installation is found in the Goodyear Venezuela plant where more than 20,000 feet of various sizes has been installed for the primary and secondary power distribution systems.

Nepco-Lok Interlocked Armored Cable is the ideal material to use where there is danger of mechanical damage. It is easy to install and gives complete flexibility. If a line has to be replaced, Nepco-Lok is 100 percent salvageable.

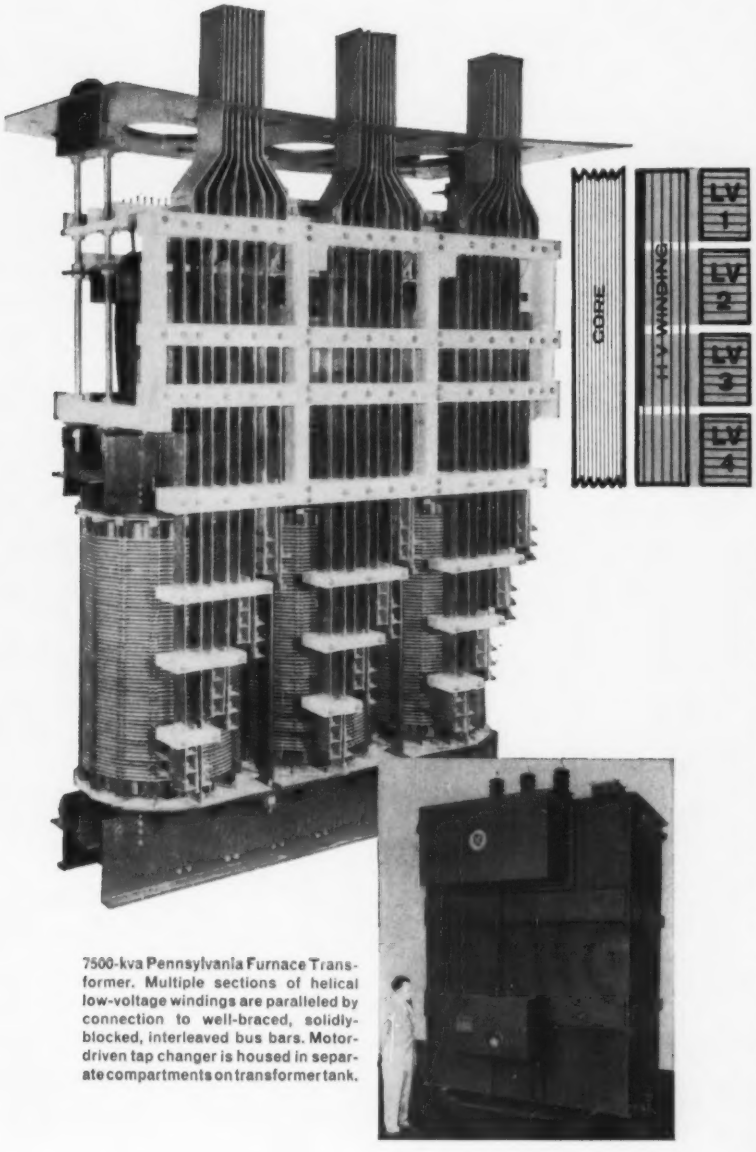
For information, write: *National Electric Division, H. K. Porter Company, Inc., Porter Bldg., Pittsburgh 19, Pennsylvania.*

NATIONAL ELECTRIC DIVISION PORTER **H. K. PORTER COMPANY, INC.**

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION, PEERLESS ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

In a quarter-of-a-century...

there has never been a failure in the helical-type secondary winding of a Pennsylvania Furnace Transformer



7500-kva Pennsylvania Furnace Transformer. Multiple sections of helical low-voltage windings are paralleled by connection to well-braced, solidly-blocked, interleaved bus bars. Motor-driven tap changer is housed in separate compartments on transformer tank.

Since 1936, when Pennsylvania introduced a new type of helical winding for the low-voltage coils of furnace transformers, there has *never* been a low-voltage winding breakdown on any Pennsylvania Furnace Transformer using this design. Here are a few of the reasons:

1. Magnetic balance is established with a sectionalized low-voltage winding. As indicated by shaded areas in the accompanying sketch, this balance is maintained section-by-section even with portions of the layer-wound high voltage winding tapped out (black area), since no distortions are created in the magnetic pattern.

2. Internal forces are low as a result of the above method. To protect further against axial short-circuit forces, coils are hydraulically compressed with a force equal to the maximum short-circuit force that might occur in service. The circular shape of the coils prevents distortion from radial short-circuit forces. Coils receive a multiple treatment of thermo-setting adhesive which securely bonds the coils together. Then they are clamped and braced in the core frame so that no deformation or displacement can occur.

3. Current balance is maintained by progressively transposing the multiple low-voltage conductors in such a way that a complete transposition is made in each section, regardless of the number of turns or sections.

4. Bus bars of opposite polarity are interleaved to reduce reactance and improve current distribution. They are well braced to prevent deflection and incidental contact during short circuit.

* * *

Briefly, these are some of the factors that account for the outstanding trouble-free performance of Pennsylvania Furnace Transformers in gruelling day-in, day-out service. To take advantage of this service-proved reliability... please contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

PENNSYLVANIA FURNACE TRANSFORMERS

McGRAW-EDISON

For the MOST DEPENDABLE GUY

YOUR

Open Helix Loop

AT THE TOP

AT THE BREAKER

AT THE ANCHOR

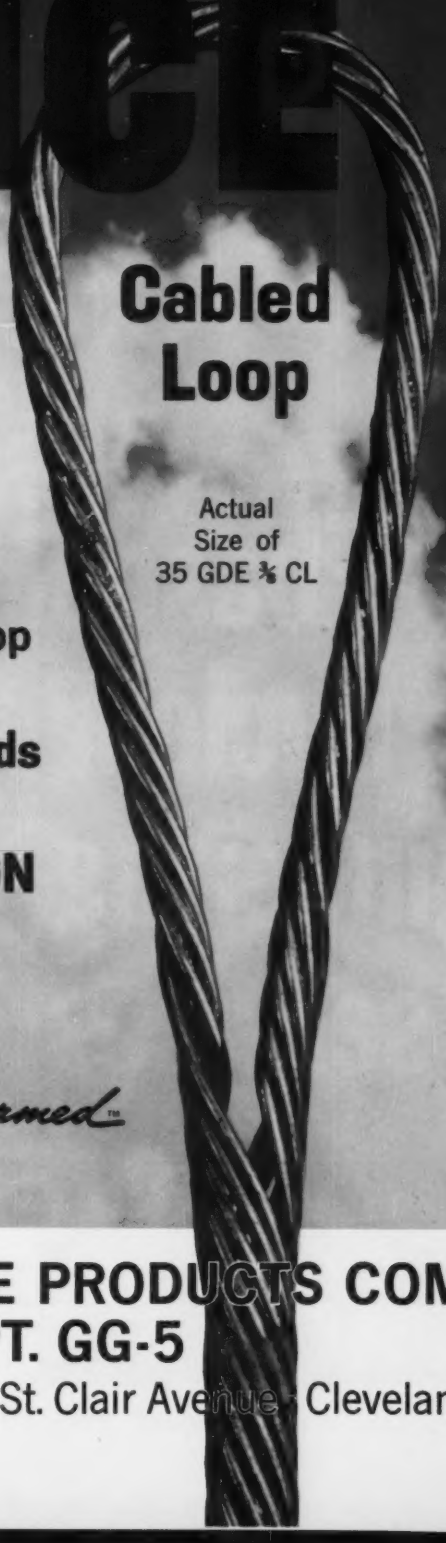
Actual Size of 35 GDE ⅜

SEE HOW all your guying requirements can be met by applying Preformed GUY-GRIP dead-ends.

SEND for 32-page Application Procedures book, "THE GOOD GUY," and the 24-page pocket-size companion booklet.

Preformed™ **GUY-GRIP dead-ends**

CHOICE



Cabled Loop

Actual Size of 35 GDE ⅜ CL

Standardize on one... or the other... or a combination of both.

Choose Open Helix Loop or Cabled Loop GUY-GRIP dead-ends TO SUIT YOUR SPECIFIC DESIGN REQUIREMENTS

You can look up to Preformed™

Patented — U.S. Patent Number 2,761,263

TRADEMARK — "GUY-GRIP"

PREFORMED LINE PRODUCTS COMPANY
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AT HOME OR ABROAD...

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Among Ebasco's growing activities in the nuclear field are these major projects:

IN AMERICA, for the U. S. Atomic Energy Commission, a conceptual design of a 306,000-kw boiling water nuclear power plant; for the AEC's Knolls Atomic Power Laboratory, engineering, design, inspection of construction, and preparation of operating manuals for the off-hull facilities for the prototype of the first nuclear powered destroyer; and for the Southwest Atomic Energy Associates, consulting nuclear engineering for the development of an advanced thorium reactor system.

OVERSEAS, for SENN in Italy, engineering and construction of a 150,000-kw nuclear power plant; and for the Japan Atomic Energy Research Institute, engineering, design and inspection of construction of a 12,500-kw nuclear power plant.

Wherever you may be planning to utilize atomic energy, Ebasco's nuclear experience can serve you well. Along with Ebasco's 54-year reputation for uncompromising quality in general engineering and construction, it can be your assurance of practical and economical results.

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- ★ Nuclear Investment Consultation
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For more information about Ebasco's nuclear engineering services, write Ebasco Services Incorporated, Dept. M. Two Rector Street, New York 6, N. Y.

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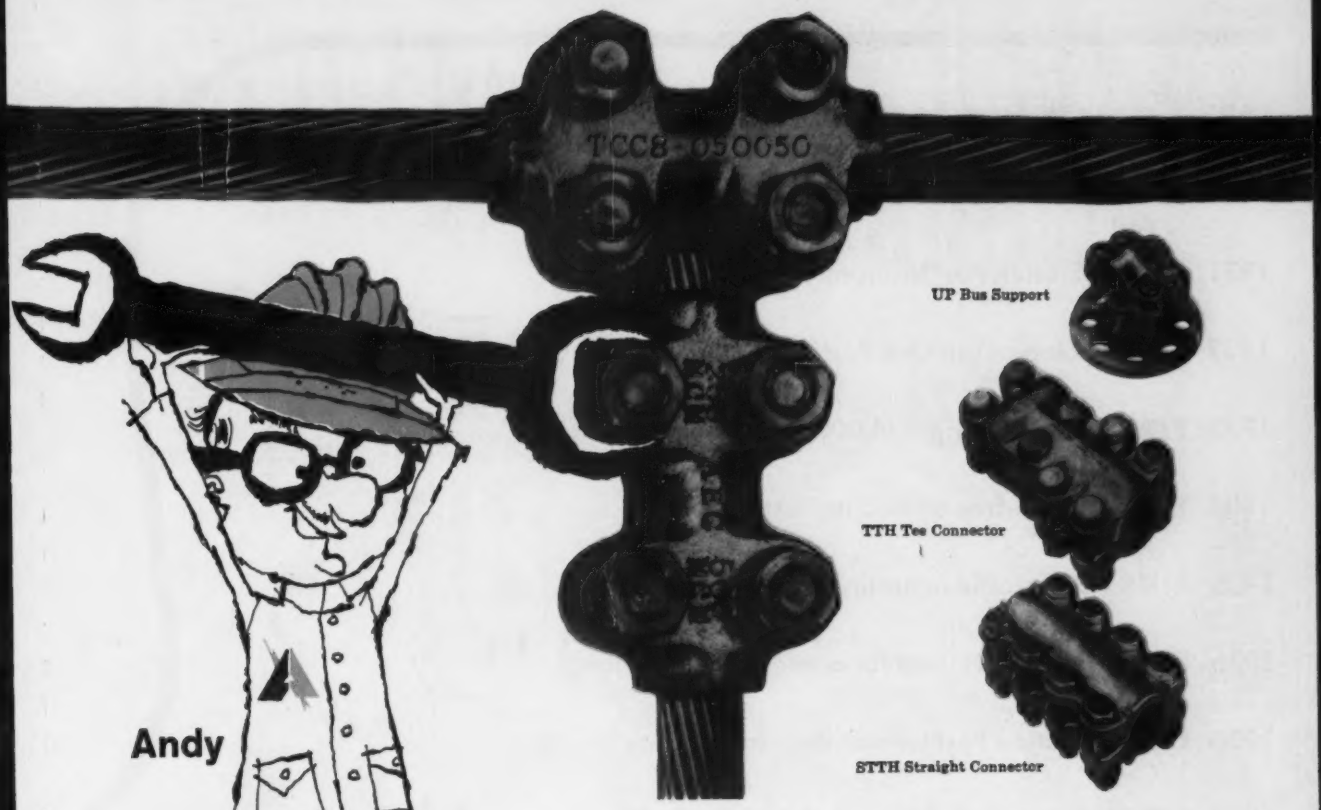

Why Utilities Demand

*Anderson Substation Connectors!

Get greater clamping pressure, easier installation, longer service life with Anderson bronze substation connectors—proven by over 30 years of use under all conditions.

- 8 bolts on tee and straight connectors insure maximum clamping pressure and secure installation.
- 3-piece tee connectors allow independent clamping of main and tap. Taps can be bolted in place on the ground and passed up for connecting to main.
- Countersunk hex head bolts provide one-wrench installation.
- Wide conductor range practically eliminates misapplication, helps cut inventory costs. Components with reversible grooves available for even greater application range.
- Cast contact surfaces insure positive electrical connections.

Be sure! Always specify Anderson substation connectors. Ask your Anderson representative or write direct to us for details.

*Anderson's Bronze Power Connectors meet or exceed N.E.M.A. Construction Standards SG1-4.04 Classes CF1, CF2, and CR2.

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ANDERSON ELECTRIC

Research / Quality / Performance / in Aluminum and Bronze Products

LAPP... FIRST IN LINE POST AND STATION POST INSULATORS

1931 **FIRST** Line Post Insulator

1931 **FIRST** Station Post Insulator

1932 **FIRST** Clamp-Top Line Post

1933 **FIRST** High-Strength (4,000 lb.) Station Post

1934 **FIRST** radio-free 66 kv Line Post

1935 **FIRST** separable mounting studs for Line Post

1936 **FIRST** Line Posts used for armless transmission

1936 **FIRST** Station Post for distribution switches

1937 **FIRST** Extra-High-Strength (8,000 lb.) Station Post

1946 **FIRST** two-piece Station Posts

1950 **FIRST** 10,000 lb. Station Post

1954 **FIRST** Clamp-Top Line Post for horizontal mounting

1954 **FIRST** Line Post for 115 kv

1955 **FIRST** Distribution Posts

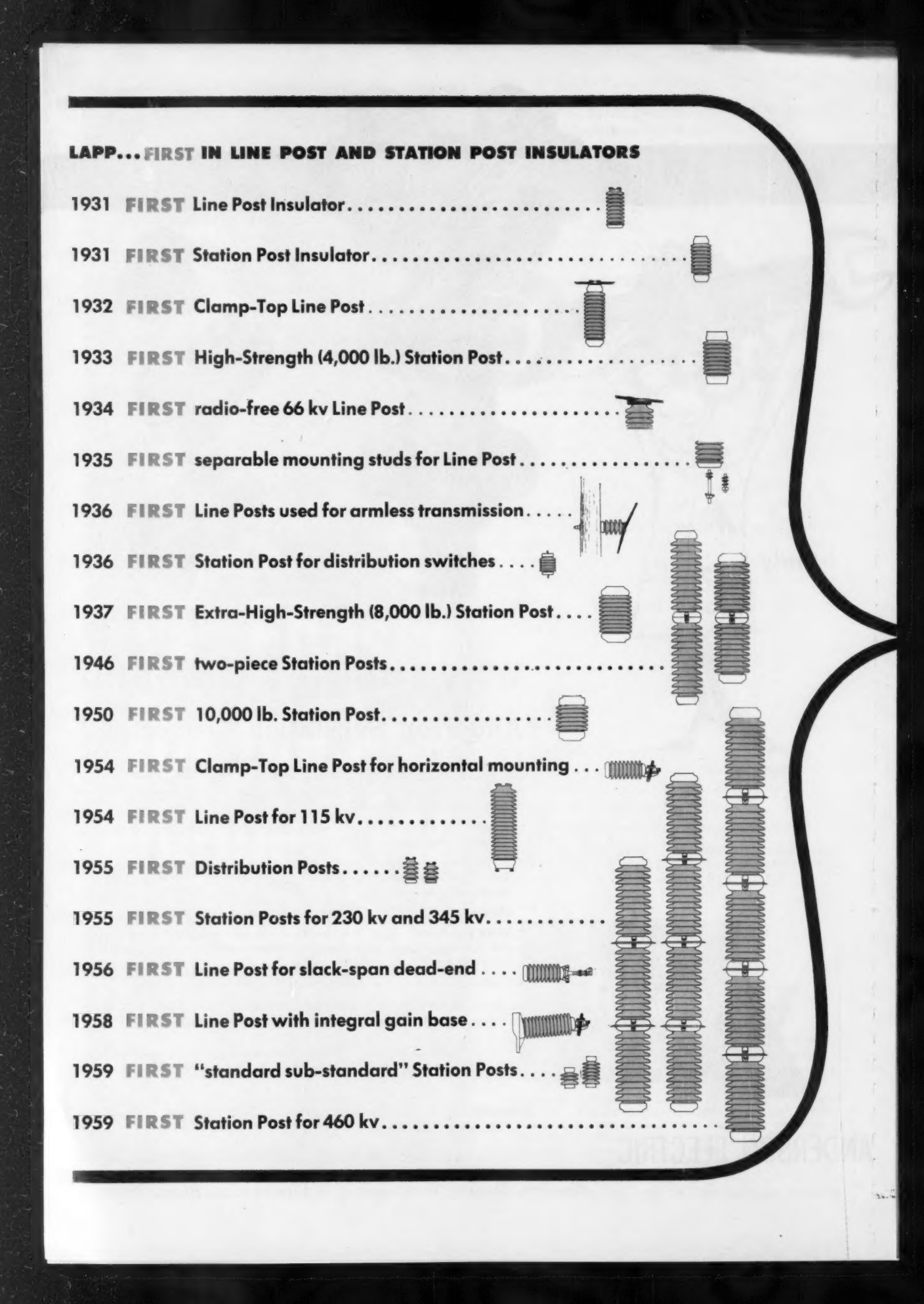
1955 **FIRST** Station Posts for 230 kv and 345 kv

1956 **FIRST** Line Post for slack-span dead-end

1958 **FIRST** Line Post with integral gain base

1959 **FIRST** "standard sub-standard" Station Posts

1959 **FIRST** Station Post for 460 kv



SUDDENLY OUR BABY'S GROWN UP!

It used to take courage and foresight to specify Lapp Line Post and Station Post Insulators... now it just takes a glance at the record.

You probably take Line Posts and Station Posts for granted. Hard not to, when records show them outperforming pin-type units spectacularly. But when Lapp first introduced its revolutionary idea, in 1931, conservative power companies took a wait-and-see attitude. They waited. Year after year they saw Lapp Posts serve without failure on lines and stations where replacements had been a problem. Finally they began standardizing on this better insulator design.

But it took years. And of course competition sniped away. Between times, they tried to copy Lapp's design, but without Lapp's patiently-acquired skills and techniques in ceramic manufacture. Now that Lapp Posts have been accepted, there is less sniping, more copying—endorsement of the fact that our baby has come of age.

If you're not yet using Line Posts and Station Posts, you ought to know how they cut maintenance and replacement costs. Your logical source is the company that pioneered, proved and perfected them—Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp Line Posts and Station Posts for many uses are shown in the new Lapp Catalog Eight. Write for your copy.

Lapp

FOR AUTOMATIC CONTROL OF STEAM STATIONS

An RW-300 system in a steam station can pay for itself by improving service continuity, increasing safety for personnel and equipment, and reducing operating and maintenance costs. RW-300 computer control can reduce the probability of major accidents, decrease the number of outages, and ensure faster return to service following an outage. In addition, through monitoring plant performance and computing heat rate, computer control can provide significant fuel savings.

Many utility leaders are now considering computer control of boiler-turbine-generator units, and uppermost in their minds is the question of system reliability. Field reliability can be proven only by on-line systems standing up under continuous service in rugged industrial environments. Every day more than a dozen RW-300 systems are operating around the clock in a variety of industries.

For further information, call or write Mr. Raymond E. Jacobson, Director of Marketing, Dept. EW-1077-1.

RW-300

the most field-reliable computer control system . . .

THE THOMPSON-RAMO-WOOLDRIDGE PRODUCTS COMPANY

a division of ***Thompson Ramo Wooldridge Inc.***

202 NORTH CANON DRIVE • BEVERLY HILLS, CALIFORNIA • BRADSHAW 2-8892

here's the inside story on Southern States cutouts and boric acid fuse links

While Southern States Distribution Cutouts are designed to function properly with other makes of fuse links, there is a measurable difference in performance when Southern States boric acid links are used—not only in our cutouts, but in other makes, too.

The cutaway view tells the inside story of why Southern States Cutouts and Fuse Links work together to provide the ultimate in fuse protection.

The auxiliary tube of the link is unusually long and sealed to the top ferrule. The fusible element is buried in boric acid powder.

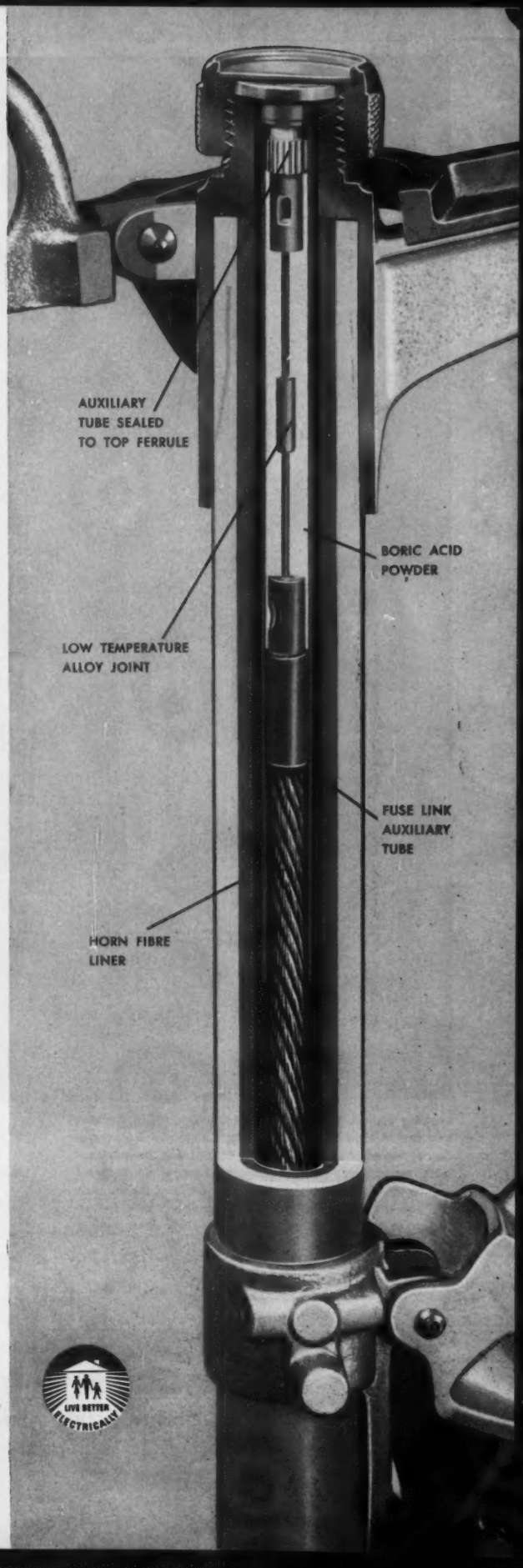
When a fault occurs, even one just sufficient to melt the fusible element, a lot of things happen fast: First, an arc is established when the element separates. The heat generated by the arc instantly converts the boric acid powder into water and then into a large volume of steam. This action performs a dual task. First, vaporization of the water and rapid expansion of gas cools the arc. Simultaneously the arc stream is purged of ionized gas by a fast-moving column of steam.

Circuit interruption is swift and sure.

At higher values of fault current, pressures generated destroy the auxiliary tube. When this happens the main tube takes over, normally clearing the fault is less than a cycle.

For the ultimate in fuse protection on low or high faults, use Southern States Cutouts and Fuse Links.

Get full information from your Southern States representative, or write for Bulletins 580C and 55PDL.



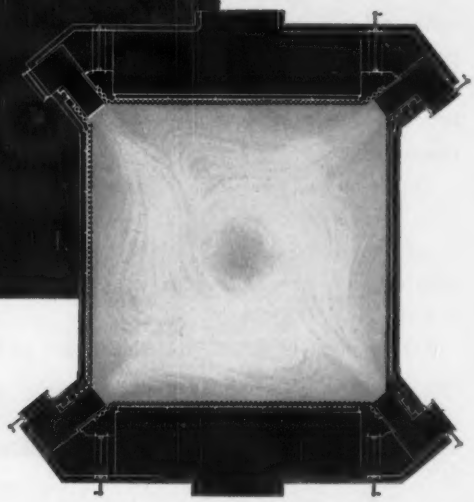
SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA Dominion Cutout Co., Ltd., Toronto

TANGENTIAL

Looking up into the furnace of a C-E Controlled Circulation Boiler. One of its four Tilting, Tangential Burners is being moved into position. The burner and its adjacent water wall tubes are shop assembled into a single panel and handled as one piece. All four corners of the furnace are similarly equipped. Tangential burners may be arranged to burn coal, oil or gas separately or in combination.

Sectional plan view through tangentially fired furnace showing impinging action of fuel streams from the burners which results in extreme turbulence and thorough mixing of fuel and air.



COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

FIRING...
best for big boilers

Tangential firing – an exclusive C-E development–was introduced by Combustion in 1927. The tilting feature of the burner nozzles, for control of superheat temperatures, was added to the basic design in the late thirties. Among the many proven advantages of the C-E Tilting, Tangential Burner, those enumerated below are especially noteworthy – whether the fuel be coal, oil or gas, or combinations thereof.

Combustion is better

1. The extreme turbulence created by impinging flame streams of adjacent burners assures the most effective mixing of all the air with all of the fuel to produce the most rapid and complete combustion. Minimum carbon loss is assured.
2. The swirling rotating travel of combustion gases fills the furnace cross-section and utilizes the heat absorbing wall surfaces most effectively.

Superheat is controlled

1. If stream temperature goes too high, the C-E Tilting Tangential Burner nozzles automatically tilt downward. More furnace wall surface becomes effective. Gas temperature to superheat surface is lowered. Steam temperature comes down.
2. Conversely, if steam temperature drops below that efficient for the turbine, nozzles tilt upward, sending hotter gases to the superheater. Steam temperature goes up – automatically.

Acceptance is widespread

About 650 tangentially fired C-E Boilers with an aggregate capacity of about 400-million pounds of steam per hour are now in service; another 85 units are under construction or on order. In 1959 alone 31 new C-E Boilers with an aggregate capacity of over 5-million kilowatts were put in operation in electric utility plants. All of these units are tangentially fired.

Thus, tangential firing has established itself in service over a period of many years as the most widely accepted method of firing for big boilers. More recently it has met similar success in smaller oil and gas fired units for capacities as low as 70,000 lbs. of steam per hour. Catalog PC 8 gives full information. May we send you a copy?

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

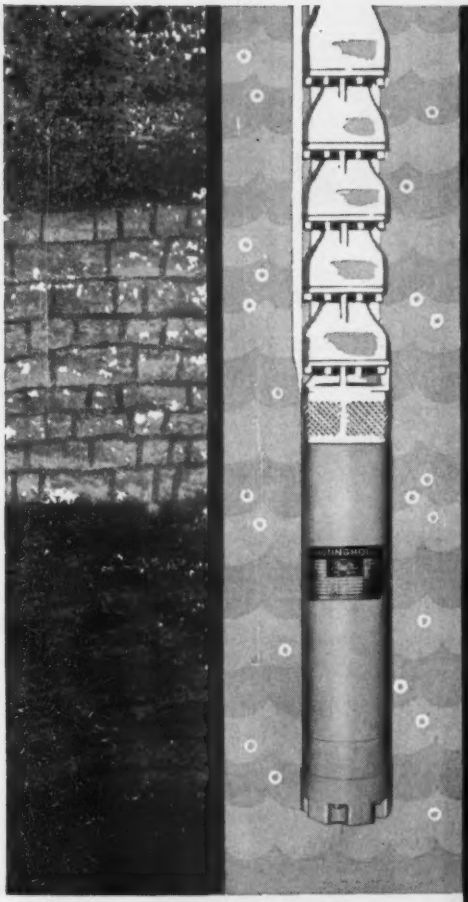
C-E

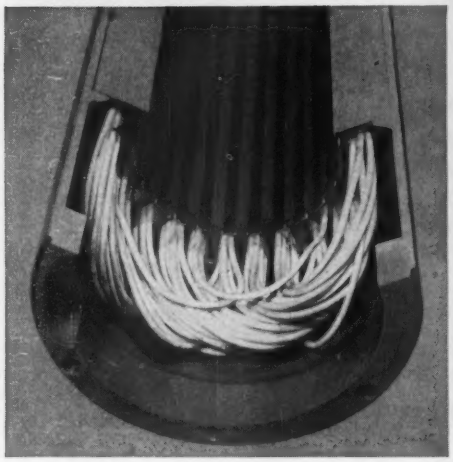
C-263

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

Another new development using

B.F.Goodrich Chemical *raw materials*





Submersible pump motors are manufactured by Westinghouse Electric Corporation, Sunnyvale, California, using waterproof wire insulation made of Geon by Sequoia Wire & Cable Company, Redwood City, California. B. F. Goodrich Chemical Company supplies the Geon vinyl.

Problem of motor submersion solved with Geon insulation

This new motor operates under water using the water itself as a lubricant. Since the housing is water filled and "breathes" well water, its operation depends on the insulation of Geon.

Geon met tough requirements. The manufacturer says that many materials were tested to find one that would stay waterproof indefinitely and also have enough mechanical strength to stand up under the winding process and under flexing imposed in starting.

A test motor was submerged under 400 feet of head for six months and subjected to frequent starting and operation. At the end of the test, the Geon insulation showed no signs of deterioration. Geon also eliminates need for thick and dense coatings over end turns—eliminating a cause of trapped heat and premature failure.

Here's another example of the way that Geon vinyls open new markets, or improve present applications. For more information, write Dept. GX-4, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

Soft Rubber Boots Prevent Injury to men or machines. A-B pendant stations are available with from 2 to 16 units, plus emergency stop unit in bottom of enclosure.

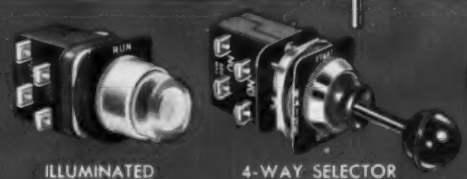
Allen-Bradley offers the

MOST COMPLETE LINE

of oiltight heavy-duty

CONTROL UNITS

The wide selection of Allen-Bradley Bulletin 800T push buttons and control units will enable you to satisfy each and every control station requirement. A-B control units and stations have seals to exclude oils and cutting fluids—contacts cannot become fouled. And *all* control units have the popular A-B double break, silver contacts that assure reliable operation—without maintenance. The rugged construction, flexibility, and generous wiring room of Allen-Bradley's Bulletin 800T line are "bonus" features. To get the best in every way—insist on Allen-Bradley. Send for Publication 6090, today.



ILLUMINATED PUSH BUTTON
Space-saving two-in-one control unit.

4-WAY SELECTOR SWITCH
Can also be furnished for 2-way operation.

ENCAPSULATED PILOT LIGHT
Transformer type for rugged 6-volt bulb.

PUSH-TO-TEST
Six different color lenses available.

SELECTOR SWITCH
With coin slot operator. Other operators available.

TIME DELAY
Delay adjustable from 0.5 to 5 seconds.

POTENTIOMETER UNIT
Furnished in 2- or 5-watt capacity ratings.

LOCK TYPE
For selector switch or push button operation.

DOUBLE CIRCUIT
Has 2 N.O. or 2 N.C. sets of contacts.

16 UNIT STATION
in die-cast aluminum enclosure. Sheet metal cabinets also available for up to 25 control units.

ALLEN-BRADLEY

Member of NEMA

QUALITY MOTOR CONTROL

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Yes, Allen-Bradley also makes...

A-B QUALITY

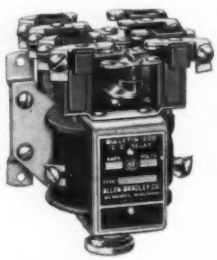
DC Contactors

Here's the only line of DC contactors using the simple solenoid design—with ONE moving part—in all ratings through Size 4. And their double break, silver alloy contacts never need servicing.

BULLETIN 202

DC Control Relays

These relays are the counterpart of the Bulletin 700 line of AC relays—of which millions are in service. With only ONE moving part—these relays provide the ultimate in long life and reliability. Like the AC line, they have double break, silver contacts that never need maintenance. Made in a variety of types and with up to 8 switching poles.



BULLETIN 200

Float Switches

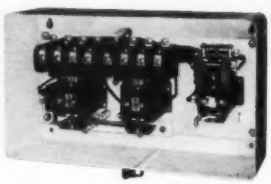
This versatile line of float switches is available in a wide range of types and enclosures to handle practically every industrial pumping job. They all feature a snap-action switch mechanism for positive operation no matter how slowly the liquid level changes.

BULLETIN 840

BULLETIN 1209

Loom Switch

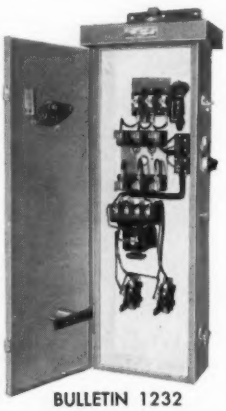
Manual starting switches designed for textile loom service. Design of operating lever makes accidental operation impossible. Lint-tight enclosure eliminates fire hazard.



BULLETIN 1270

Automatic Transfer Switches

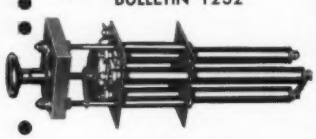
For use where power must be maintained, these panels automatically transfer the load to an auxiliary supply when normal supply fails or falls too low. Transfers automatically when the normal power supply is resumed. Mechanically interlocked.



BULLETIN 1232

Pump Control Panels

Designed for irrigation and oil field pumping applications. Can also be used with outdoor lighting systems. Uses standard A-B Bulletin 709 solenoid starter with manual disconnect switch or circuit breaker in weatherproof enclosure. Available with many optional features.



BULLETIN 410

AC and DC Rheostats

Provide absolutely stepless control over a wide resistance range. Full wattage capacity available at all settings. Sizes to 5400 watts.

4-60-RM

ALLEN-BRADLEY

Member of NEMA

Quality **Motor Control**

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

NOMINAL WEIGHTS OF FINISHED WEATHER-RESISTANT WIRE AND CABLE

(Pounds per 1000 Feet)

Conductor Size AWG or Mcm	Copper & Copper Alloy Conductors: URC Type Double Braid	URC Type Triple Braid	Neoprene Type	Polyethylene Type	Aluminum Conductors: Neoprene Type	Polyethylene Type
Stranded						
2	246	270	248	**230**	105	**87.4**
4	155	170	163	**143**	73.3	**53.3**
6	103	115	108	**91.5**	51.5	**35.0**
Solid						
2	239	260	232	**219**	92.2	**79.2**
4	151	164	152	**136**	64.0	**48.0**
6	100	112	101	**87**	45.7	**31.7**

Sources: American Standards Association Specifications

This table shows

POLYETHYLENE covered line wire weighs less

Because it's the lightest, polyethylene-covered line wire is the easiest for linemen to string up . . . hardest for ice and snow loading, gale-force winds to bring down.

Polyethylene-covered line wire, depending on size and conductor, weighs from 5% to 32% less than other types. That's what the figures in the specifications tabulated above show.

This, of course, is no news to linemen who have strung all types of weatherproof line wire. They may not be able to quote pounds and percentages, but they all know you can't beat polyethylene on weight.

Linemen's Favorite Material

Light weight means easy handling, one of the main reasons polyethylene rates tops with installation crews. They also like polyethylene wire because it's clean . . . free-stripping . . . has a smooth, self-lubricating surface that almost makes pulling a pleasure. And despite the exterior slip, the plastic covering hugs the conductor tightly, doesn't ruffle as it goes over crossarms.

"Built-in" Safety Factor

Polyethylene's lightness provides lasting mechanical advantages, since span loads don't tax supports as much as heavier type wire. This "built-in" weight safety factor pays off when violent storms push aerial construction to strain limits . . . when ice and snow loads topple heavier lines.

An added factor in polyethylene wire's ability to stay up under adverse conditions is its smaller diameter. It offers less resistance to wind, a smaller surface for ice build-up.

Winning Combination

Called the "closest to the ideal covering for line wire," polyethylene is outstanding in other respects too. The shield it forms over wire is continuous . . . tough . . . resistant to aging, weathering, moisture, abrasion by lashing branches. It's good for decades of superior service marked by fewer outages, minimum maintenance.

When you order covered wire and cable, make sure the coating is made with PETROTHENE® polyethylene resins. PETROTHENE polyethylene costs no more, but it gives you premium weather and stress-crack resistance.

Polyethylene's advantages are outlined in an informative new U.S.I. data sheet, "Polyethylene . . . The Best Line Wire Covering." Also available is a data sheet showing properties, applications and specifications of PETROTHENE polyethylene compounds. Send for your copies today.

U. S. Industrial Chemicals Co.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.

Please send me:
- ☐ "Polyethylene . . . The Best Line Wire Covering"
- ☐ "PETROTHENE Resins for the Wire and Cable Industry"

Name:_____ Title:_____

Company:_____

Address:_____

City:_____ State:_____

USI INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York, 16, N. Y.
Branches in principal cities

Question:

How does Duquesne Light Company approach the problem of locating 23 kv substations in closely built-up residential areas?

Answer:

By using completely metalclad substations with S&C metal enclosed fused load interrupter switchgear developed cooperatively by Duquesne and S&C; and by putting the 23 kv and 4 kv circuits underground (as shown at right).

3-bay S&C switchgear unit for primary of Duquesne Light Company substation.

Q. Why is S&C metal enclosed fused load interrupter switchgear suited to substations in closely built-up residential, commercial, and industrial areas?

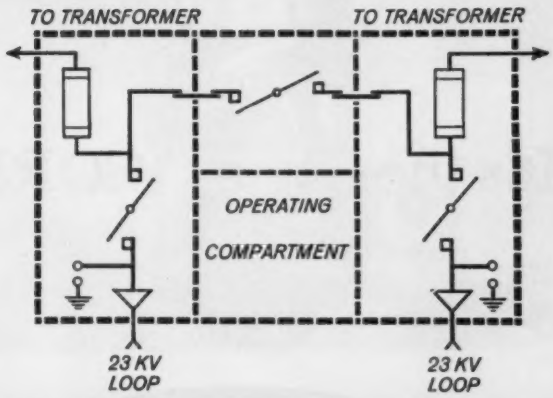
A. Because it gives safety to the public, attractive appearance, and compactness.

Q: How is attractive appearance achieved?

A. By eliminating steel structures or wood poles, exposed switches, potheads, fuses, and lightning arresters. This gear is also streamlined so that a Duquesne substation offers a low silhouette which fits unobtrusively into its surroundings.

S&C

Specialists in High-Voltage Circuit Interruption



Q. What does compactness mean to Duquesne?

A. Large sites are not required for these substations, thus the difficulty of site procurement, not to mention the cost, is significantly reduced.

Q. Why was S&C chosen to participate with Duquesne in this cooperative program to develop a completely metal-enclosed 23 kv substation?

A. Because S&C had developed compact load interrupters for arc-free switching, as well as a correspondingly compact power fuse with controlled exhaust—both ideally suitable for metalcladding.

Q. How can utilities learn more about the use of S&C metal-enclosed fused load interrupter switchgear?

A. Write for additional information to S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Illinois. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 18, Ont.

S&C METALCLAD FUSED LOAD INTERRUPTER SWITCHGEAR

In Transformer Rebuilding . . .

Specify Wagner Form W Replacement Assemblies for full NEMA Standard Cores and Coils with new low impedance and lower core losses.

Rebuild your own transformers? Send your rebuilds out? Regardless . . . it pays to specify Wagner Form W Replacement Core and Coil Assemblies. Do it, and get full NEMA Standard elements, exactly like those used in new Wagner Transformers.

You get the advantages of lower impedance values, better regulation and lower losses. You get the most out of up-rating,

It's the CORE & COILS *that count*

too. In sizes through 15 kva, you can install the largest cores and coils that will fit your tank, and still remain within NEMA temperature rise standards.

Wagner Replacement Assemblies, in ratings from 5 through 167 kva, come to you ready to install. They have been fully tested, vacuum-treated and dried, and are packaged in transformer oil for complete protection. Universal mounting brackets are included with each unit, 25 kva and smaller.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

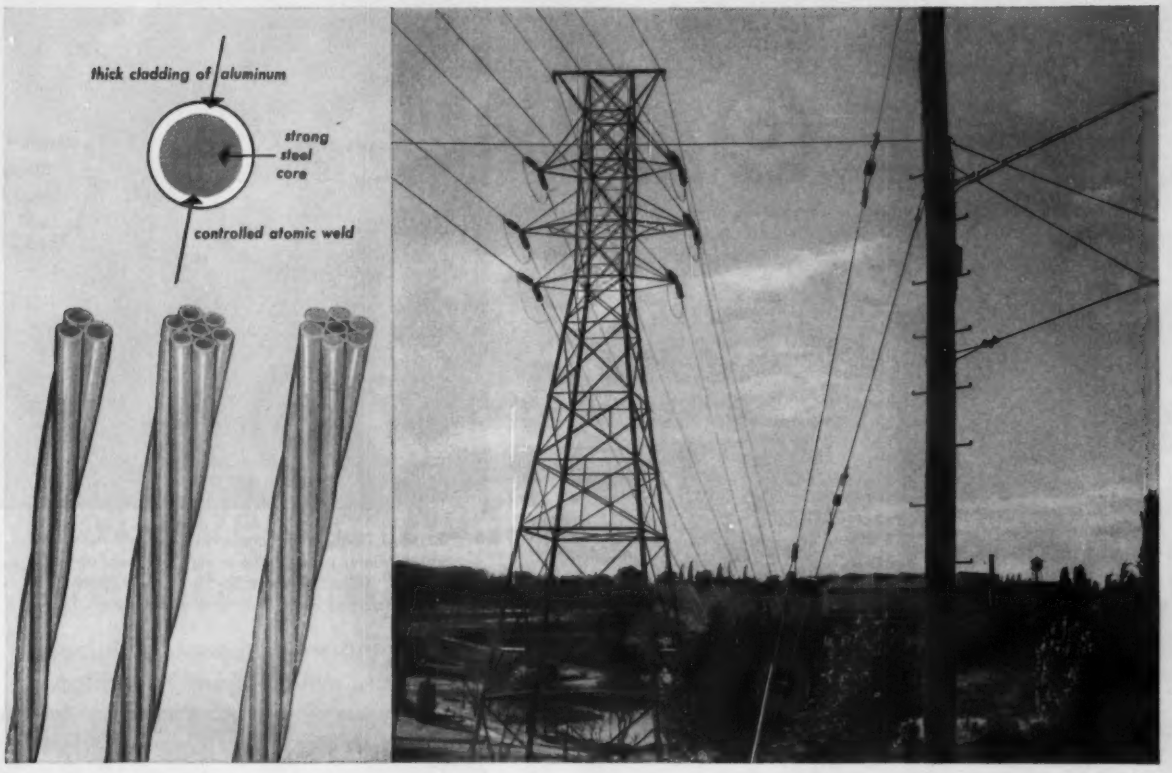
Wagner Electric Corporation
6456 PLYMOUTH AVE., ST. LOUIS 33, MO.

WR60-6

SERVING 2 GREAT GROWTH INDUSTRIES – *ELECTRICAL • AUTOMOTIVE*

The *Alumoweld technique* of welding aluminum to steel

means TOP PERFORMANCE... LONG LIFE... LOW COST



● You cut costs and assure top performance of your overhead lines when you use Alumoweld for overhead ground wire, guys, messengers, and ACSR core wire ● You'll have no maintenance worries because a thick cladding of pure aluminum permanently protects Alumoweld's high-strength steel core from corrosion. In fact, Alumoweld has the same corrosion resistance as solid aluminum wire—and 33% of the electrical conductivity. Compared to steel, Alumoweld has three times the conductivity . . . is 18% lighter . . . just as strong . . . and will last far longer.

For overhead ground wire, Alumoweld is tops. The high strength-to-weight ratio permits stringing with smaller sags, thus increasing the mid-span clearance. Its excellent conductivity quickly discharges lightning currents to ground—reduces service interruptions.

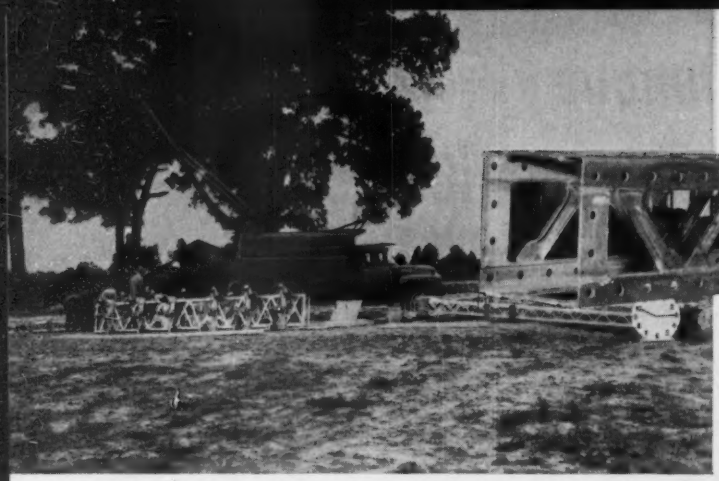
For guys and messengers, Alumoweld gives long, trouble-free life because it cannot rust. And it's strong and easy to install.

For core wire in ACSR Conductors, Alumoweld eliminates the danger of electrolytic action because it is compatible with solid aluminum wires. It coordinates the life of the strength members with that of the conductor members.

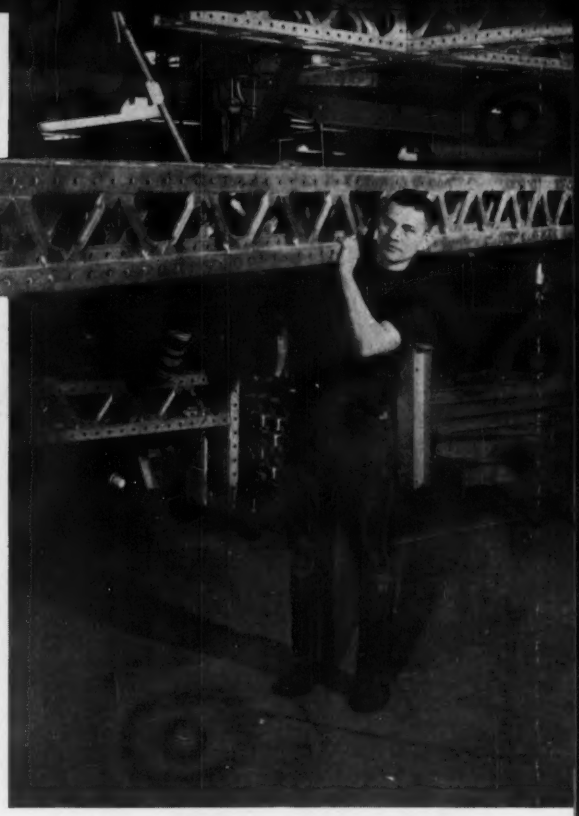
Get all the facts on this low-cost wire and strand by writing today for bulletin E.D. 3000.

ALUMOWELD

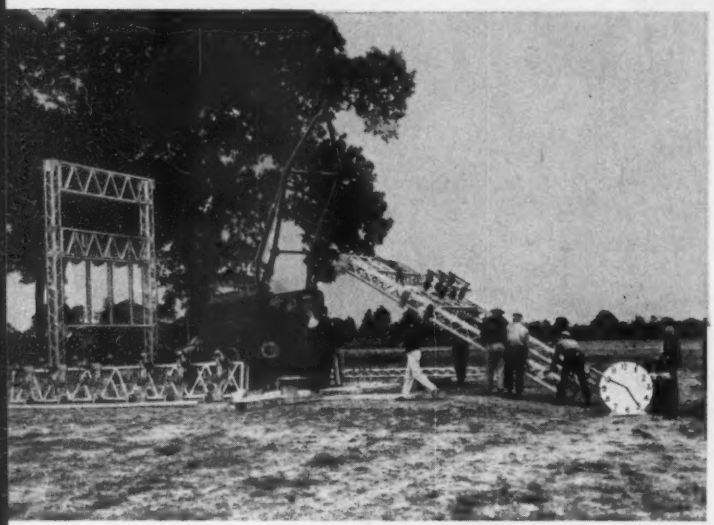
COPPERWELD STEEL COMPANY



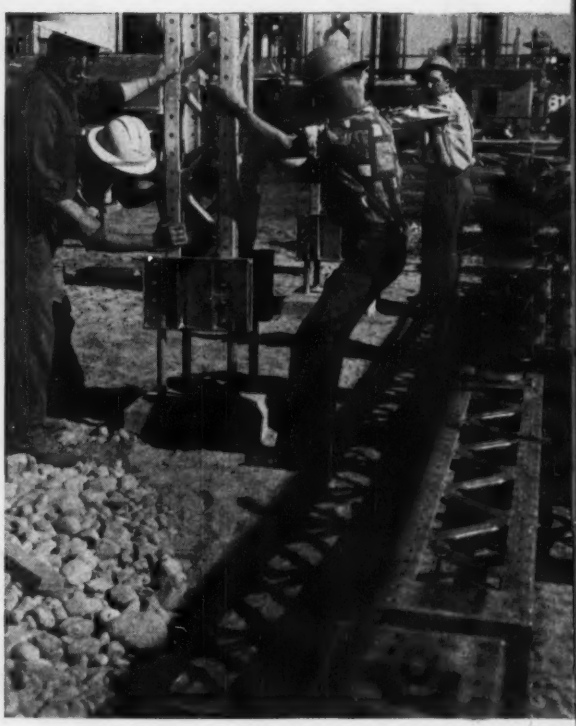
10:15 A.M. Erection of the L-M-Alrectic substation commenced. Linemen use their regular line-truck hydraulic hoist. Columns and trusses were bolted together, and equipment was mounted before the sub-assemblies were erected.

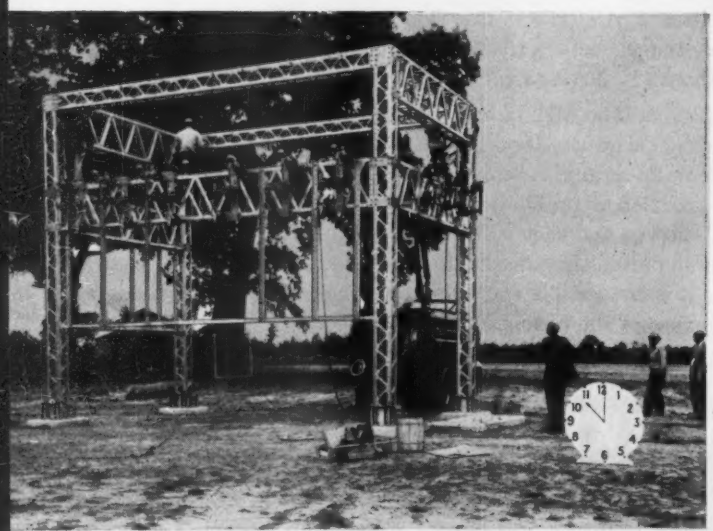


THE SPECIAL DESIGN and construction of L-M-Alrectic substation trusses provide the strength of steel at less than ⅓ the weight. Trusses can be handled on the ground without the aid of mechanical equipment.



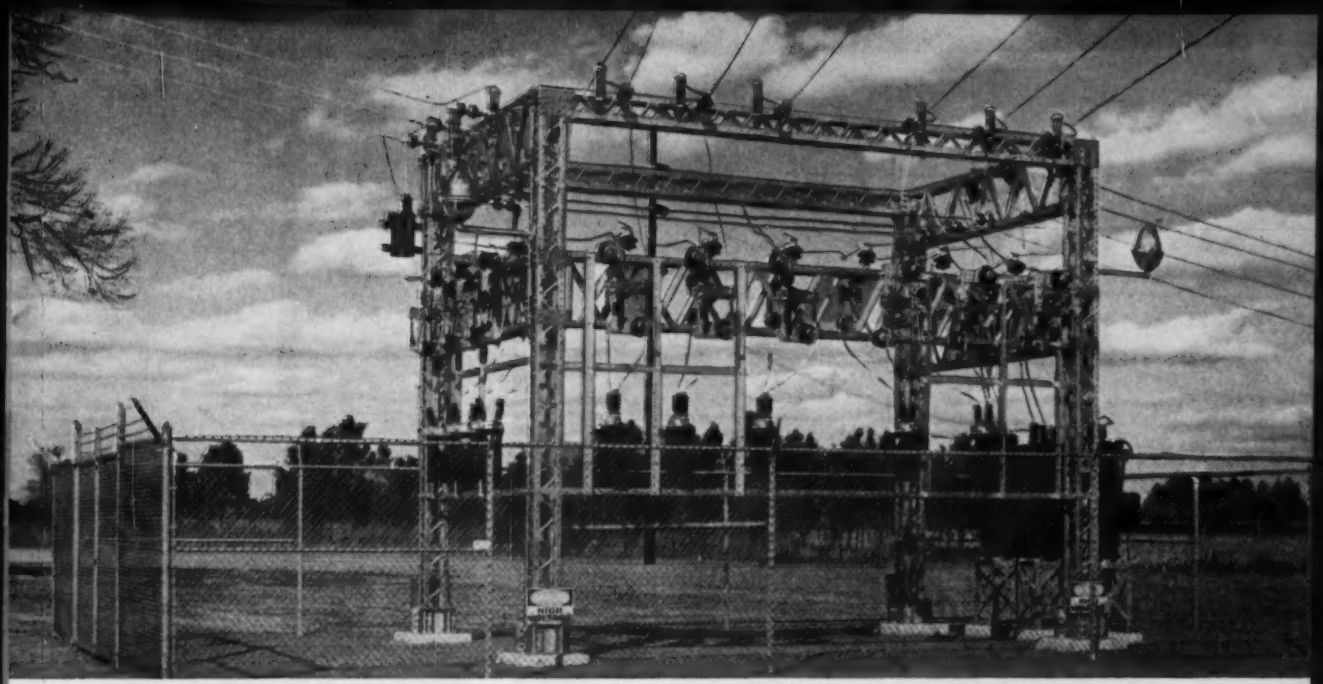
10:25 A.M. In only ten minutes, one column and horizontal truss sub-assembly are already erected. The second is being erected here.





11:03 A.M. Within 48 minutes, the entire Alrectic structure is erected and ready for bus work. Only 18 working hours after material was received the station was ready to be energized.

THE EASE with which this crew guides the base plate over the anchor bolts shows why installation of L-M-Alrectic substations is faster and more economical.



THIS 12 kv REGULATED SWITCHING STATION was erected by a line crew in only 48 minutes. Although this crew had no previous erection experience, the men were still able to install this L-M-Alrectic aluminum substation in an amazingly short time. Columns and horizontal trusses were bolted together and equipment was mounted before the sub-assemblies were erected. Sub-assemblies were then hoisted by means of the regular line-truck hydraulic hoist.

L-M-Alrectic® Aluminum Substations Are Competitive With Steel Structures

Special light-weight design, which facilitates faster installations, makes L-M's aluminum substations competitive with steel substations on an erected basis.

by **W. V. SWAN**
Product Manager
Power Switching • Substations
Line Material Industries

L-M-Alrectic aluminum substations are constructed with standard factory-assembled trusses. Each truss consists of specially designed extruded chord-angles and lacing members that are factory-welded, using fixtures. Because of special design and construction, Alrectic trusses weigh only 30% of comparable steel trusses, but bear equal stresses.

Fast, Economical Installation

Column and horizontal trusses are all pre-assembled when delivered to the job site. They need only to be laid out and bolted together. Alrectic substations are fabricated of aluminum and require no special treatment—no painting, no maintenance. As a result, distortion from galvanizing is eliminated and assembly problems are minimized.

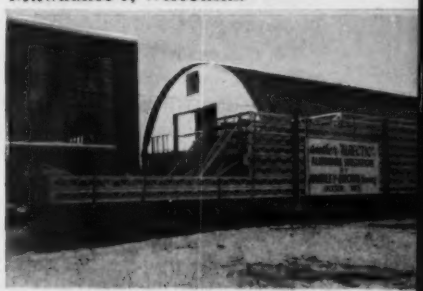
Because of lighter weight, the trusses are easy to handle. Much of the structure can be ground-assembled without a crane. Ground-assembled structures can then be lifted into place with light-duty lifting equipment. Erection of Alrectic substations is easier, faster and, above all, more economical.

Alrectic Competitive with Steel Substations

Special light-weight construction, most economical design, and fast economical installation make it possible for L-M to supply the Alrectic aluminum substation at costs equal to and, in many cases, lower than, steel structures.

Get Complete Information

Be sure you contact your L-M Field Engineer and get all the facts on the Alrectic aluminum substation. The next time you plan a substation, ask your L-M Field Engineer to submit a bid on an aluminum structure. Or write me at Line Material Industries, Milwaukee 1, Wisconsin.



ALL ALRECTIC columns and trusses are fabricated at the factory and are shipped pre-assembled. Light-weight design permits shipping the entire substation on one truck or rail car.

® Registered trademark of Handley-Brown Company

LINE MATERIAL Industries
McGRAW-EDISON COMPANY
439 **Substations and Power Switching Equipment**

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

HORACE E. BISHOP, peach and dairy farmer of Inman, South Carolina, tells Duke Power's Edwin O'Shields how the L-M Suburbanaire adds hours to his day, beauty and safety to his home.

THE ADDITION of this L-M Suburbanaire now permits launching and reloading of boats at Lee's Boat Haven, near Clover, South Carolina, any time of the day or night.

Duke Power Provides Low-Cost Lighting For Piedmont Carolinas

Rental plan for suburban and rural areas offers low-cost protective and convenience lighting for farms, filling stations, small townships.

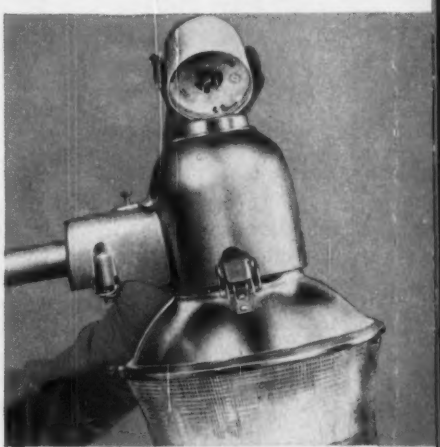
The extensive Duke Power Company system includes 33 branches from the Virginia line to the southern boundary of South Carolina. One important aspect of this progressive utility company's merchandising and public relations program has been to sell its customers on better outdoor lighting.

To make such lighting available at low cost, Duke Power Company offers its customers individual photocell-controlled luminaires, such as L-M's Suburbanaire, on a full-service contract. For $3.00 a month, the company supplies the unit itself with a 7000 lumen mercury vapor or 6000 lumen incandescent lamp, pole, installation, service, and power, on a rental basis with a service contract.

The lighting plan is widely used in the Company's territory at farms, service stations and garages, industrial areas, and for small township street lighting jobs. Under the plan, which has been in operation only since October, 1958, the utility has several thousand units in service.

How-To-Do-It Information

For details on how Duke Power Company and other utilities have put the plan into operation, ask your L-M Field Engineer or Lighting Engineer; or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials Ltd., Toronto 13, Ontario.



THE L-M SUBURBANAIRE is a specially designed, easy-to-maintain open-type unit, available with photocell and for either incandescent, or with ballast for mercury vapor lighting. High efficiency is achieved with scientifically designed reflector-refractor combination. Available in IES types I, II, III, V, and 4-way type II light patterns.

404

LINE MATERIAL® Industries Outdoor Lighting

McGRAW-EDISON COMPANY

DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS
POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

McGRAW EDISON

Editorial Comment

MARCH 28, 1960

A Second Computer Milestone Beckons

The industry is entering a new decade with successful application of the digital computer to utility accounting an accomplished fact. This prominent milestone has been attained through the vision and the determination of a few companies that have lead the industry in its use. Their progress is presented in this issue.

But another milestone beckons—the complete exploitation of the digital computer in utility system engineering planning and design. A handful of companies already are moving toward this goal. More are sure to follow. Their progress can be slowed by a situation that didn't present itself in accounting applications. The accounting system is the direct means of producing the customer's bill, maintaining files, and preparing reports for management. Savings in these operations can be estimated before the computer is put to work.

In engineering applications, on the other hand, the computer does not turn out the end product. It is merely the instrument for determining what savings, if any, can be made through a comprehensive approach to planning and design. Savings will be apparent only after the studies are completed, and human judgment exercised in applying the answers.

This then is the fundamental difference between the results of accounting and engineering uses of the digital computer. Appreciation and understanding of this difference will encourage engineers to make swift progress toward the second milestone.

Wanted: A More Palatable Word Than 'Demand'

The word "demand" may well be doomed to deletion from the electric utility lexicon. In its place could come a word more palatable to utility customers—such a word as "capacity," "requirement," "load," or "use." At least this seems to be the prospect offered by nearly 100 qualified respondents to a meter manufacturer's query "Why call it demand?"

Few of these respondents questioned the need for rates reflecting peak demand as well as integrated usage. But they bowed as one man to the necessity of finding a word more acceptable than "demand" for use in their rate structures.

What word do they consider more palatable? In this, unfortunately, they are far from agreement, suggesting nearly 50. But the most frequent choices were "capacity," alone or in combination with "cost," "reserve," or some similar modifier. This group polled an inconclusive 18 votes. Even if it is credited with such write-ins as "availability," "standby" and "service," it is still in the minority.

Second choice in this survey fell to such words as "requirement" or "reservation," closely followed by terms including "load" and by terms including "kilowatt." This group, augmented by scattered votes based on "use" or "power," rolled up 35 votes, implying that another ballot might establish a clear superiority.

The choice of word remains confused. And the industry is far from agreement on how extensively to bill for peak usage—particularly for residential service where most utilities consider it unpalatable and burdensome. But there is no mistaking the desire to find a word less odious than "demand" for the billing of services which justify its measurement. We urge utility executives and engineers—particularly those most involved in serving and billing customers—to come up with a new term which has all the desirable qualities and will be fully palatable to the man who pays the bill.

Three Groups Prepare Arguments

Investor-owned utilities and an organization of preference customers are at odds on problems of ownership, marketing, engineering, construction schedules, transmission routes

When the House Public Works subcommittee convenes, probably in the next two weeks, it will hear arguments from at least three groups interested in the Colorado River Storage Project. These are:

- Five investor-owned utilities will present one transmission plan that involves investment by both themselves and the government (EW, Nov. 30, 1959, p 86);
- Colorado River Basin Consumers Power, Inc, an organization of preference customers, will present a transmission plan that is totally federal owned; and
- The Upper Basin Colorado River Commission, made up of commissioners from the five states involved, will attempt to divide the five-state market into a four-state primary market, leaving Arizona and parts of California and Nevada within the drainage basin of the Colorado as a secondary market.

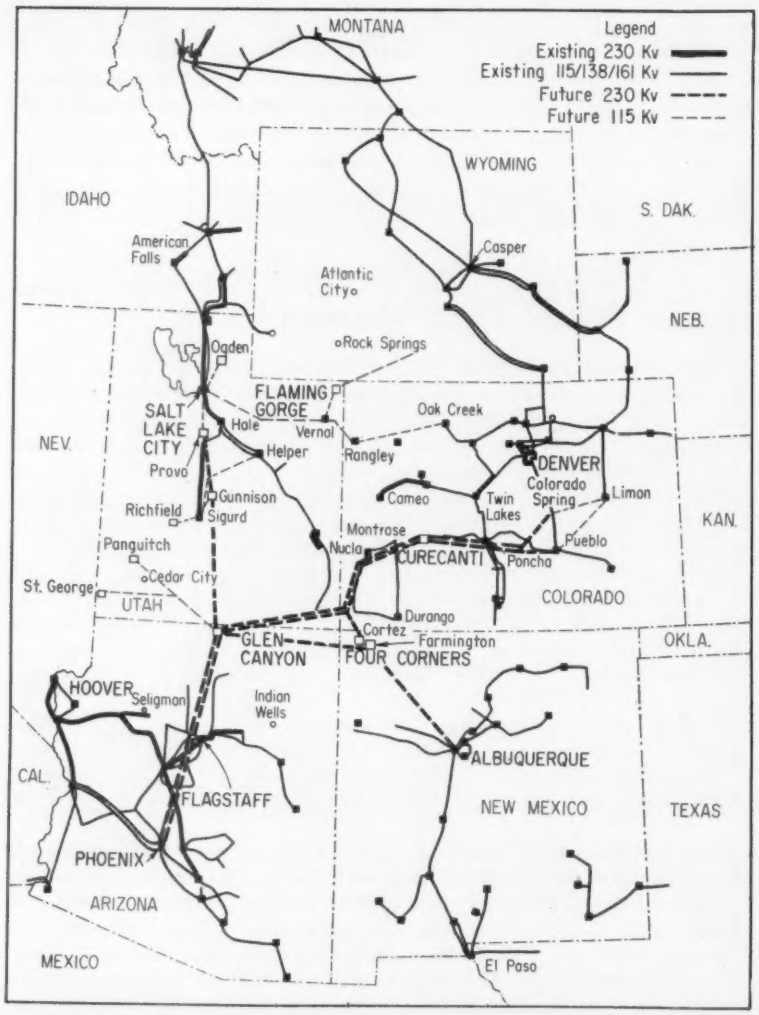
A report prepared by the preference customer group takes the stand that there will be no firm power available to investor-owned utilities after the needs of preference customers have been satisfied. The River Commission gives private utilities third and fourth priorities for power following (1) preference customers in the four upper basin states and (2) preference customers in the secondary market area. Private utilities in the four upper basin states would have a third priority and those in the secondary marketing area would have fourth.

Immediate construction by the federal government of transmission lines from Glen Canyon Dam in Arizona to Curecanti, Colo., and from Flaming Gorge Dam in Utah to Oak Creek, Colo., will be recommended to the subcommittee by the preference group. Although the routes are not identical, the private utilities are also recommending federal ownership of these links in the grid.

The report that will be submitted by the preference group was prepared by the Kuljian Corp. Basic differences between private utilities and preference group transmission routes are in the Four Corners area and in the way Arizona would be served. These differences are primarily because Arizona Public Service Co and Utah Power & Light have a plan for a major tie-in with each other (EW, Oct. 12, p 88). Other differences occur at points where the private utilities propose tie-in with their existing systems instead of U.S. Bureau of Reclamation lines to avoid duplication of facilities. Both plans call for 230-kv or lower transmission voltages over most of the grid, but the private utilities' plan is for three 345-kv circuits from Four Corners to Phoenix.

In the report, Kuljian Corp states:

"While not designed primarily for the benefit of private utilities or with capacity for private utility loads, nevertheless the system as shown is strategically located for interconnection with private utility systems so that the maximum advantage can be



PREFERENCE CUSTOMERS' PLAN has less capacity in some portions of the system

for Upper Colorado Appropriations

gained, to the mutual benefit of all concerned, in integration, interchange and common reserve." There is considerably more 230-kv line in Colorado and Wyoming in the private companies' proposal than in the one that will be submitted by the preference group.

Both plans are designed with Arizona considered a primary marketing area as opposed to the River Commission designation as a secondary market. But the preference group states "By not later than 1980 the states of Colorado, New Mexico, Utah, and Wyoming can absorb all of the project firm power."

One big difference in the two proposals is that the private utilities have told the USBR that they will expand steam generating facilities to supplement power from the hydroelectric projects (EW, March 14, p 63). The utilities expect to install at least 16,000 Mw of capacity by 1980, according to their report submitted to USBR Oct. 1 (EW, Nov. 30, p 86). This is about 15 times the total capacity of the authorized CRSP plants and accounts for their plans for more transmission capacity.

Construction Schedules Differ

There are some differences in the construction scheduling in the two reports, also. The preference group lists Glen Canyon with 600 Mw in 1965, 810 Mw in 1970 and 1975. Private companies schedule it for 550 Mw in 1965, 675 Mw in 1967 and 900 Mw in 1970. Flaming Gorge is scheduled for 100 Mw by 1965 by both reports. Curecanti is listed with 145 Mw capacity in 1970 by the preference group and with 100 Mw capacity at the same time by the private companies.

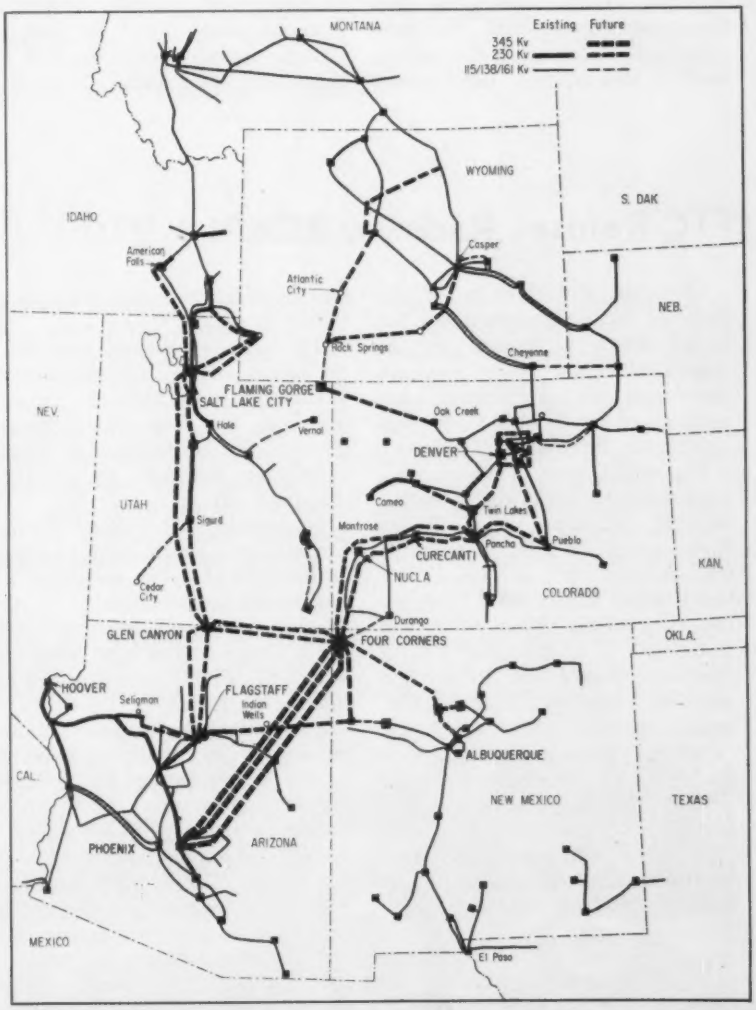
Flaming Gorge is scheduled to begin producing power in June 1963 and Glen Canyon in June 1964.

The private company report estimates transmission investment by the involved utilities and USBR will ultimately be $124 million. The preference group estimates federal expense will be about $144 million if wood pole construction is used, or $155 million if a combination of wood and steel is decided on. The private companies make no distinction as to type of structures, stating, "Each transmission line shall be designed to provide continuing future usefulness and be compatible with long term network requirements.

Discussion of plans to meet with Congressional appropriations committees revealed that there is some disagreement among members of the Upper Basin Colorado River Commission. Commissioner John Bliss of New Mexico said it was his "unpleasant duty" to inform the group that New Mexico and Colorado are unable to agree on Navajo Irrigation Project and the Animas-La Plata project. He implied he would not support appropriations arguments favoring them. However, at this point the two would only be up for authorization in this session of Congress.

The House Appropriations Subcommittee on Public Works will hold the closed hearings April 11.

Actually, the subcommittee has before it only a budget request for $518,000 to continue planning on the lines, plus a minor part devoted to obtaining rights-of-way along the route that will be built by the government regardless of which plan is accepted.



PRIVATE UTILITIES PLAN calls for 345-kv transmission in southern part of grid

McNaughton Says Passamaquoddy Not

High interest rate on New Brunswick provincial bonds renders Canadian portion of financing too uneconomical

The long-proposed Passamaquoddy Tidal Power Project on the U.S.-Canadian border suffered a strong, although unofficial setback recently when Canadian Gen A. G. L. McNaughton told a parliamentary committee in Ottawa that the project isn't economically feasible at present.

McNaughton is Canadian co-chairman of the six-man International Joint Commission which has charge of such projects along the U.S.-Canadian border. He told the Canadian House of Commons' External Affairs Committee that Passamaquoddy would be built "eventually," along with several similar all-Canadian tidal power projects around the Bay of Fundy, producing several million kilowatts of power. "What you can't do (now) on a small scale, you can do on a large scale when the time comes," he said.

Passamaquoddy would have a power capacity of 550,000 kw, cost about $687-million, according to present plans. The major problem lies with financing of Canada's half of the international project, due to present high interest rates on New Brunswick provincial bonds. U.S. financing, through federal bonds, is considered possible. However, Passamaquoddy won't be built if Canada doesn't finance its half of the project. It's doubtful whether the U.S. would, or could build the entire project alone.

Washington sources say McNaughton's remarks are somewhat premature in that the IJC hasn't heard final testimony on Passamaquoddy, and the Commission probably won't make its final recommendation on the project to the U.S. and Canadian governments for many months. A tentative hearing April 22 has been set to be held in Calais, Me. At that meeting U.S. and New Brunswick local interests will have a chance to testify on the project.

Canadian Difficulties Not New

The content of McNaughton's remarks isn't entirely new. The IJC Engineering Board—in its January report to the full Commission—pointed out that financing of

FTC Refuses Radin on ECAP

Chairman Earl Kintner of the Federal Trade Commission has turned down a request by the American Public Power Assn to investigate the truthfulness and accuracy of the Electric Companies Advertising Program (ECAP).

His denial came in answer to a request several weeks ago by APPA General Manager Alex Radin. Radin asked the FTC to make "a full investigation" of the ECAP series, which Radin called "misleading, inaccurate, filled with half truths . . . a disservice to the American people and to the advertising industry itself" (EW, Mar. 7, p. 11).

Kintner pointed out that such studies aren't the responsibility of the FTC, but should instead be considered by Congress. He said, "This advertising is not directed toward promoting the sale of the advertiser's product. Instead, it is directed to the reader in his capacity as a voter . . . the representations in the advertisments deal primarily with questions of a political nature, which are of a type for the Congress, rather than this agency (FTC), to decide."

The issue—or the tax-deductibility aspects of it, at least—is now in Congress in the form of a bill introduced by Rep Hale Boggs (D-La.). His bill is aimed at "Censorship by Taxation" by the IRS (See page 12).

Meanwhile, the Federal Power Commission—which held hearings on the right of power companies to account for contributions to ECAP as proper business expenses—will get its final round of legal briefs on March 31. FPC is now expected to rule on the issue.

The outlook for a favorable ruling for the 76 companies involved is not bright, since FPC Hearing Examiner Edward Marsh—backed up by the full Commission—denied the companies the right to justify their accounting procedures. The only testimony allowed in the ECAP hearing was whether or not the ads were "political in nature." An appeal to the Federal U.S. Court of Appeals is expected to follow an unfavorable FPC order.

Electric

Hundreds of utility executives and their wives were eager riders in three Henney Kilowatt electric cars unveiled to the industry at the Southeastern Electric Exchange in Boca Raton, Fla. Built by the Henney Motor Co, a division of Eureka Williams Corp, the Kilowatt uses a Renault Dauphine body, a traction motor, and a new stepless control developed by General Electric Co, Eureka Williams, and Atlantic City Electric Co. The cars are the first of a limited production run intended specifically for the utility industry. They will be used by utilities to build up public interest and develop road test data to determine the final design and feasibility of an electric car.

Two of the Boca Raton cars will be used by Atlantic City Electric Co; the third, by Eureka Williams. Of the two additional cars already produced, one is committed to Illinois Power Co. Several power companies are understood to be seeking the fifth car. To date priority requests have been received from over 30 utilities for

Feasible

the project, for Canada particularly, was extremely questionable, if not completely unfeasible at present.

Francis Adams, U.S. member of the IJC, said he hadn't seen McNaughton's remarks, but that he believed the Canadian general was simply reiterating information that was made available to the Commission in the Engineering Board's report. Adams agrees that financing of Passamaquoddy is tenuous. Adams adds that the IJC Engineering Board had made great progress in its report, which showed for the first time that the tidal power project could be built across a deep channel with rapid tides.

And Sumner T. Pike, chairman of the Maine Governor's committee to promote Passamaquoddy, has admitted that, "at best," the project is "10 years away."

Utility Wins Reversal Appealing Damage Suit

Union Electric Co. St. Louis, successfully appealed a court decision that would have cost the company $35,000 in damages for a home that was destroyed by fire caused by a short in the electrical system.

The service entrance to the new home was arranged with the meter outside the garage wall and a circuit breaker inside the garage. A short circuit occurred in the 5-in. length of conduit connecting the two and set the building on fire, destroying it and its contents.

Union Electric was held responsible in the first court decision because two 10-amp fuses on the transformer serving the house and a neighboring dwelling had withstood the short circuit and allowed it to continue for some 10 seconds or more, creating a temperature of 2,900 F which melted the conduit and ignited the wood in the wall.

Reversing the first decision, an appellate court contended that the utility could not be required to provide protection for defects in wiring owned and controlled by owners of the house.

Arizona Public Utility Object of Taxation Bill

Legislation to force special electrical power districts to pay income and property taxes is before the Arizona Legislature.

The bill is aimed specifically at the Salt River Project which operates in competition with Arizona Public Service Co.

Sponsors of the bill, Rep V. S. Hostetter and Douglas S. Holsclaw, both Pima Republicans, say Salt River Project avoids $9 million annually in Federal, county, and state taxes.

Cars Intrigue SEE Utility Executives

more than 70 cars. Current price is $3,500, but this is expected to be reduced with volume production.

"Based on the warm interest exhibited, indications are that we will receive a substantial number of new utility orders in the near future to reinforce the backlog we already have," commented President C. Russell Feldman of Eureka Williams. He said the current model, admittedly rushed into fabrication to catch the meeting schedule, is already obsolete from the standpoint of desired improvements. According to Eureka Williams engineering chief Charles Stoneson, the number of improvements to be made and the production schedule will depend largely on the level of utility orders in the next month. Eureka Williams will continue to demonstrate the car at utility meetings.

Reaction of utility executives was one "of reserved interest." The prototype cars are adjusted for maximum efficiency and range, which holds down top speed and acceleration. Some utility men felt that for their use the cars should be adjusted to attain better acceleration, even at the expense of range.

Top speed of the Kilowatt is reported to be 35 mph. Range is 40 miles per day if run constantly and 50 to 60 miles if operated at moderate speed with frequent stops. The batteries regenerate somewhat during stops of 15 minutes or more. Built-in silicon rectifier rechargers will be standard on the Kilowatt.

Speaking of the car's potential as a load builder, Carl O. Carlson, executive vice president Atlantic City Electric Co, pointed out that an electric running 6,000 to 7,000 miles per year would use 3,000 to 3,500 kwhr, close to the average residential usage, but would require utility capital investment of only $100, compared to approximately $400 for a new residential customer.

FIRST MODEL OF HENNEY KILOWATT, a new electric car, is turned over to Atlantic City Electric Co Executive V.P. Carl O. Carlson, right, by C. Russell Feldman, Eureka Williams President at Southeastern Electric Exchange meeting

Southeastern Talks on Personnel Problems

Importance of safety programs, good communications and management development all highlight Mississippi talks

"The future outlook for the utility industry will not depend on an improved technology, nor on the ability to finance our companies, but rather it will be good or bad depending on how effectively we answer the threats of those who would socialize our industry." R. Baxter Wilson, president of Mississippi Power & Light Co said this at the Southeastern Electric Exchange Accident Prevention and Personnel Administration sections in their joint conference at Jackson, Miss.

Wilson, setting the conference theme added, "The effectiveness of our own efforts will depend largely on how well we communicate and sell utility employees on the fundamental and basic principles involved."

The problems of maintaining effective employee relations were attacked from several viewpoints, particularly those of :

- Management selection, appraisal and development;
- Employee communication;
- Safety efforts.

Management development is an activity that increases the capacity of the individual to perform his presently assigned duties or which helps to qualify him to perform duties of increased scope, according to F. G. Lippert of American Electric Power Service Corp. Managers and supervisors get developed day in and day out, whether or not a company has a formalized development program. All that a program does is organize the effort and make sure that no one is overlooked and that three or four likely candidates are available when it comes time to make a selection. The everyday value of management development is not only in the preparation of people for promotion, but in the improved performance in present assignment which results from encouraging men to develop themselves, and then helping them to find ways and opportunities to do so.

Communication is the most important facet of employee relations, and sincerity is the key to good communication, says James H. Beckham, Alabama Power Co. "We consider the first-line supervisor as the most important clearing house in our system of communications," he added.

The first-line supervisor interprets company programs, plans, and policies to the employees; and—regardless of whether his interpretations are correct or incorrect—the employees are inclined to take them as the meaning that management intended, and their attitudes and opinions are thusly molded. For this reason, most of Alabama Power's communication and training is aimed at the supervisor.

H. E. Hatfield, Georgia Power Co, observes that the greater portion of problems arise from the group in the bargaining unit, and this is the group where safety is stressed most highly. Therefore, the safety man is in a position to be a key communicator. Consequently, the safety man must command respect by his actions, sincerity in the manner in which he approaches the job, and by confidence put in him.

"H" Frame for EHV Will Be Studied

Experiments with wood pole "H" frame structures for 345-kv transmission lines will start soon near Terre Haute, Ind. Illinois Power Co will build the test line near Indiana & Michigan Electric Co facilities. Highest voltage in the Illinois Power system is 230 kv, so Indiana & Michigan will supply power from its equipment.

Two large electrical equipment manufacturers and three pole suppliers are participating in the experiment. They will provide equipment and aid with engineering measurements during the two-year test.

If "H" frame construction proves satisfactory, Illinois Power engineers believe EHV transmission line costs could be reduced as much as $10,000 a mile. One expected benefit is a reduction of line "galloping" during ice and wind storms because the "H" frames will be closer together than steel towers would be.

Another purpose of the experimental line is to study the problem of maintenance and insulator replacement with conductors energized. A manufacturer of hot line tools will assist with this part of the tests.

In charge of the experiment for Illinois Power is Theodore W. Schroeder, chief electrical engineer. He will be assisted by Glen England, transmission and distribution engineer.

Robinson Attacks Nez Perce Filing

Kinsey M. Robinson, chairman of the board of Pacific Northwest Power Co and president of Washington Water Power Co, sharply criticized the Washington Public Power Supply System for filing for permission to build Nez Perce dam on the Snake River (E.W., Mar. 21, p 68).

Robinson said PNP had selected the High Mountain Sheep project after many months of extensive and costly engineering work. He called it "the best all-around multipurpose project in the Middle Snake, offering the region power and flood control while protecting the vital fisheries resource of the Salmon River." Robinson commented that "Every responsible agency is in agreement that the Salmon River fish problem at Nez Perce is so great it might require 15 to 20 years for a solution."

Now: Lower-Cost Spinning Reserve

New concept combines characteristics of high-efficiency base-load unit with less-efficient unit to handle short-time loads on modern power systems economically

M. K. MORRISON, Large Steam Turbine-Generator Dept, General Electric Co, Schenectady, N. Y.

To cut the cost of meeting daily peak load demands encountered on all power systems, a new "spinning reserve" type of steam turbine generator installation has been conceived that combines in one unit the characteristics of highly-efficient base load capacity and less-efficient additional short-time capacity.

Such "spinning reserve" installations, when properly integrated with base load machines, and possibly gas turbines, may help achieve greater overall system generation economy than is possible with the traditional pattern of adding only high-efficiency, base load units.

Significant features of "spinning reserve" installations are:

- Additional 30 to 40% short time capability
- Low incremental cost
- Reduced maximum capacity plant cost
- Low operating costs
- Favorable maintenance costs
- Excellent base load heat rate
- Improved light load heat rate
- Satisfactory incremental capacity heat rate
- Additional capacity quickly available

Most power system have been expanded, in the past, by adding the highest efficiency generating units that could be justified economically and in the largest ratings compatible with the cost of providing reserve capacity. Each new unit operated initially at high load factor in baseload service. But as newer, more efficient generating units were added, older units were assigned to lower and lower load factor operation, to short-time peaking service, and ultimately to reserve status where they were seldom operated.

In the past this pattern of system expansion was an econominal one for two important reasons:

- Improvements in station heat rates were being achieved rapidly. Thus the industry realized large fuel savings by installing higher efficiency generating units.
- It was not then possible to make large savings by designing a generating unit specifically for low load factor or peaking service.

Use of higher steam conditions and the reheat cycle have been largely responsible for the gains in coal consumption made over the years in U.S. average coal rate, and best unit coal rate, shown in Fig 1.

A striking example of what has been accomplished in over-all plant heat rate is shown in Fig 2, which is based on Federal Power Commission data. In 1950, only two stations in the U. S. had a net heat rate under 10,000 Btu per kwhr. But by 1958 the number had grown to 56. And of these 24 operated below 9,600 Btu per kwhr.

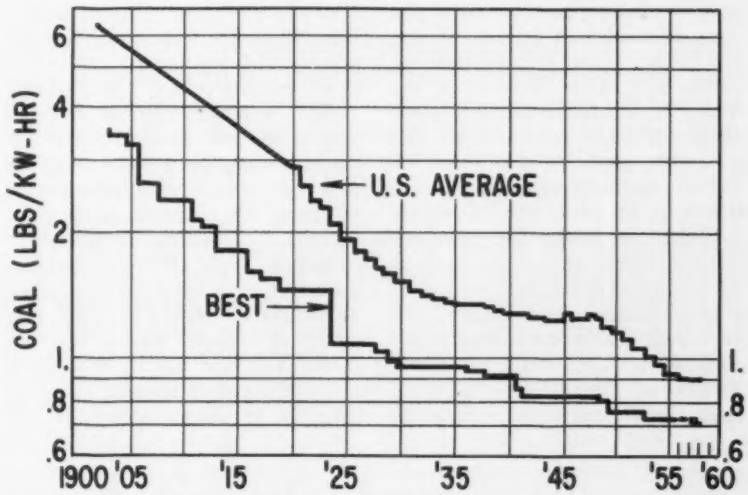


FIG 1—GAINS IN COAL RATE for the nation, and for the best unit, have accompanied the use of higher steam conditions and the reheat cycle, over the years

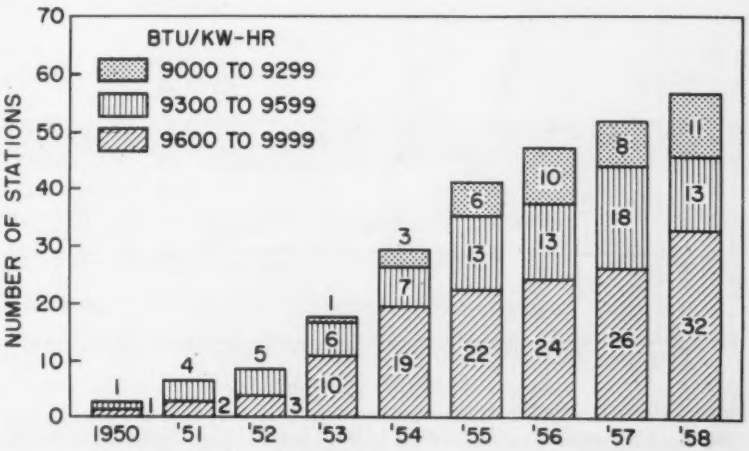


FIG 2—OVERALL PLANT HEAT RATE has improved steadily since 1950 with improvements in steam cycle. In 1958 there were 56 plants under 10,000 Btu

This rapid decrease in plant heat rates, for a typical system, has resulted in base load being carried by units with about 9,500 Btu per kwhr heat rate; the intermediate portion by units of 12,000 Btu per kwhr or more; and peak loads by 15,000 Btu per kwhr or more.

If this traditional expansion pattern was continued for, say, the next 15 years, generating unit characteristics would probably be distributed in the same manner, but the heat rate spread would be reduced. The newest units on the system would have a heat rate considerably better than today's best, but today's best units would be operating at relatively low load factor. Even peak load would be carried by units of quite low heat rate. Thus the spread in heat rate between the newest and most efficient unit on the system, and the units used only for peaking, would be smaller. Because of this it may be more economical on many systems to add a portion of the new generating capacity at a lower initial cost but with some sacrifice in fuel costs for short time operation.

Today, to satisfy the heat rate trend described above, new types of generating units are becoming available which can achieve greater overall system generating economy than could be achieved if the traditional pattern of adding only high-efficiency, base-load units is followed.

- For the peak portion of the load low-cost gas turbines are available
- For the intermediate portion of the load, to better fit many daily load cycles, "spinning reserve" steam turbine-generators have been developed
- For the base-load portion, higher-efficiency steam turbines using more advanced steam conditions, and the combined steam-gas turbine coal-burning plant are being made available.

Each of these generating-unit types, embodying new concepts, has its place in meeting the portion of the load for which it is best suited. Their availability indicates the trend the industry may take to keep the cost of power low.

Peaking gas turbines and base load steam turbine generator installations have been discussed in many articles and papers. But just what is a "spinning reserve" installation?

The "spinning reserve" installation is one that uses several extra-capacity characteristics of complete power plant equipment which have not been fully exploited in the past. Usually the capacity, or rating, of base-load, high efficiency turbine-generator units has been established at or near the output at which efficiency is highest. Today, this approach may limit a modern turbine's maximum output because technical progress in materials and designs often permit an output greater than that established by optimum efficiency. Therefore, new steam turbine-generator units may be made capable of greater than their optimum efficiency output rating if the efficiency limit for this incremental power is removed. For example, a steam turbine can be designed for a maximum efficiency base capacity of 1.0, with an excellent base heat rate. The same turbine can be designed to deliver 30 to 40% more output with a plant heat rate that is 15 to 20% poorer than the base.

Assuming relatively cool condenser circulating water, the exhaust end of the turbine normally is sized for optimum efficiency at a steam flow considerably below its flow-passing and mechanical capabilities. This characteristic may permit the use of a relatively small low-pressure turbine section where efficiency considerations alone would indicate the choice of a much larger low-pressure section for continuous operation at the greater capacity, eg, use of a triple-flow turbine rather than a quadruple-flow turbine.

Studies indicate that additional short-time boiler capacity of a comparable amount may be available to match this turbine characteristic, particularly in the case of coal-fired boilers, by overfiring the boiler. However, the boiler firing rate must be returned to normal in time to prevent excessive slag deposits accumulating in portions of the boiler.

If these extra-capacity characteristics of the turbine and the boiler are properly combined in the philosophy of station design, reserve margin which is often present in such station auxiliary equipment as boiler feed pumps, circulating pumps and, coal-handling equipment can be applied to the extra-capacity operating period without adding proportionate cost to these auxiliaries. Similar additional capacity may also be available in many gas-fired boilers, particularly those designed initially for conversion to coal.

When these characteristics of the turbine-generator, the boiler, and associated auxiliary equipment of a generating plant are exploited, they can offer additional capacity above base-load, high-efficiency capacity. This incremental capacity can be obtained with attractive investment savings. Such a "spinning reserve"

(*Continued to page* 134)

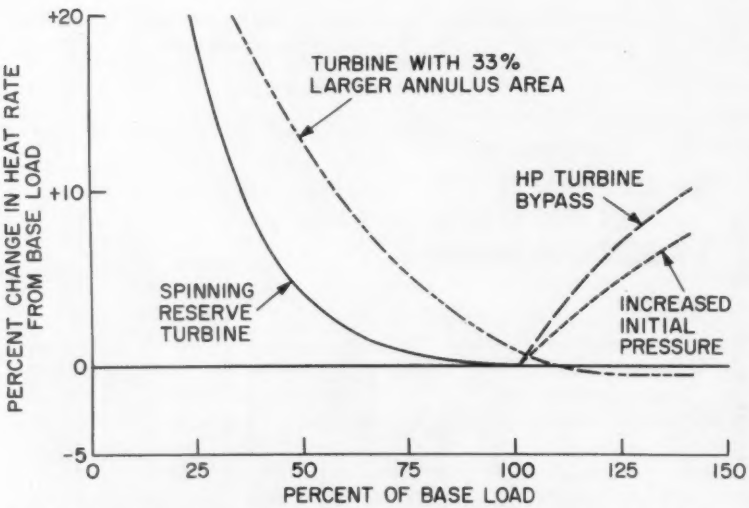
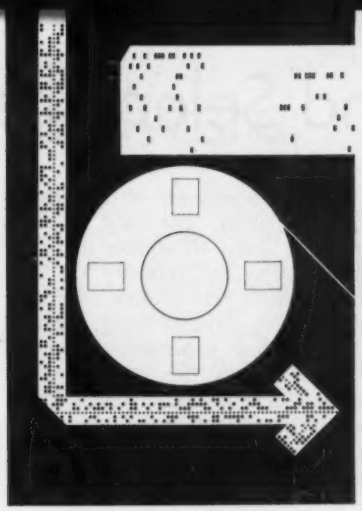


FIG 3—TURBINE HEAT RATES for two methods of getting spinning reserve turbine capacity show by-pass method slightly poorer than increased pressure method at maximum capacity. At base load, heat rate of spinning reserve unit is ½ to 1% better than unit with larger exhaust end



A Special Report

Electronic Data Processing

● The processing of data in the electric utility industry is undergoing a dynamic revolution from manual or mechanical manipulation to electronic digital computer methods. This revolution already has given those utilities that pioneered the movement a more economical, more efficient, and more powerful tool for the processing of volumes of data necessary to utility accounting operations. Through the exercise of imagination and agressiveness, these and other companies are expanding the revolution into every area of utility operations.

FRANCIS J. KOVALCIK
Methods Editor

To determine the dimensions of this revolution, and its implications for the industry, Electrical World has made the first comprehensive study of present and planned uses of the digital computer. Cooperating in this study were over 40 companies that either have computers in operation or plan to install them in the near future. Information was requested also from major manufacturers of computer systems for data processing.

The resulting mass of information was compressed into this 16-page special report to give the industry an insight into the selection, installation, and operation of a computer system for data processing. With this report goes our sincere appreciation to those companies and manufacturers that provided the information to make it possible. To them and to those companies on the brink of the revolution, we offer this special report in the hope that it will hasten the attainment of the rewards offered by electronic data processing.

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Set Your Objectives and Select the

Companies with computer experience tell what they hoped to gain and how they selected their particular systems

● The electric utility industry is in the midst of a mushrooming revolution—the transition from mechanical or electronic machine methods to the stored-program digital computer system—for all operations that come under the headings of accounting, record maintenance, or preparation of data for management control. This revolution began when utilities became aware that the stored-program digital computer had the ability to process volumes of data quickly, more accurately and with greater reliability than other methods.

To take a measure of this growing revolution, Electrical World surveyed about 40 utilities that are now leading the industry in this movement. Two groups of companies were asked to report the results of their experiences—Group A, with at least one year of computer system operation under their belts; Group B, with less than one year's use or in the installation or active-planning stages.

The revolution took form when the pioneering utilities in Group A looked more closely at the digital computer to measure its capabilities against these primary objectives:

- Greater economy in the processing of volumes of data was the aim of six companies. One of these companies, which started with a punched-card system, now feels a tape system will offer even greater economy for customer billing and accounting, as well as less manual intervention.
- Meet the demands of company growth on space for added equipment and personnel to handle the accounting operation, said five companies.
- Greater accuracy and uniformity in data processing was desired by five other companies.
- Reductions in clerical personnel was the aim of four utilities.
- Faster processing of data, and an improvement in the accounting service rendered to customers were the goals, respectively, of three companies each. Faster processing through less handling of punched cards was especially sought by one utility. Another hoped to be able to maintain customer records on a more up-to-date basis.
- Replacement of old mechanized equipment, reported two companies.

Detroit Edison, which adopted a large-scale computer system in March, 1957, embarked on a "blue-sky" study to find if a computer would provide an opportunity to give better service to customers, streamline clerical routines, consolidate files, and standardize company policy in the areas affected. Its study, which took about one year, showed that considerable savings would accrue. Wisconsin

Computer Systems Should Be Studied Carefully

Features	Considered Important by Number of Utilities in Group A	Group B
Internal speed	14	11
Time sharing	6	6
Peripheral operations	14	14
Master record layout	10	9
Computer design and timing estimates	10	13
Memory requirements	13	15
Installation cost	9	11
Conversion problems	2	1
Reliability	2	0
"Short-cut" programming	4	1

Selecting a Particular Computer

Basis for Selection	Reported by Number of Utilities in Group A	Group B
Lowest cost regardless of operating time	0	1
Maximum computer for fixed dollar amount	2	4
Completion of operations in fixed time	1	9
Lowest cost	4	5
Proven performance	..	2
Specific computer features	6	1
Site preparation	1	..
Only computer then available	1	..

Electric Power, which went to a medium-scale computer in August, 1955, also wanted to streamline procedures as well as integrate and simplify its accounting operations. Another company felt a medium-scale computer was the proper preliminary step to a larger-scale system.

Other objectives to be gained through the use of a digital computer were: A better-looking and more informative bill; improvement in and additions to information available for management decisions; performance of studies and analyses not feasible by clerical methods; ability to handle customers' bills under an increasing complexity of tariff structure; and overcoming the limitations of an electronic accounting machine operation that could cause a curtailment of data processing activity. One company, which started with a medium-scale computer (card system), is looking at a tape system for its management control possibilities and because of limitations of a card system in certain accounting applications.

More Utilities Get into the Act

Even though the companies in Group A were still on their way to attaining their objectives, a second group of utilities decided it was time to get into the act. They were encouraged to consider computer systems by several factors: The indication that economies could be obtained, although in a longer time than first estimated; entrance into the field of more manufacturers of digital computer systems; and a more discriminating knowledge of utility accounting and data processing problems on the part of the manufacturers.

Utilities in Group B set their sights on these objectives:

- Significant savings in clerical costs, reported 11 companies.
- Control of costs in handling increasing work volumes, said three utilities.
- Better information produced in less time for management use was the aim of five companies.
- Improvement in service to customers, said three companies.

Other companies reported these objectives: Economy of operation from centralized and integrated data processing; better data for engineering decisions; a chance to replace old mechanical equipment; and faster preparation of customers' bills. One company decided on the basis of the availability of a computer system designed primarily for commercial data processing. Another is studying computers because they can handle an increased number of applications.

Once the utilities' appetite for computers had been whetted by the promise of greater economy, accuracy and speed, they faced the big problem of determining whether the computer could actually deliver. Most companies in Group A decided to tackle this problem in two steps—determine the feasibility of using computer systems in accounting and other applications; determine whether the use of computers actually would be economical.

Among companies in Group A, the length of the time spent on the feasibility study varied all over the map. Formal studies of medium-scale computers ranged from 30 days to one year, with about half the studies taking less than a year. One company reported it studied a medium-scale computer informally over a two-year period. Of three feasibility studies of large-scale systems, one took seven months, the second one year, the third three years.

It is significant to note that when companies using medium-scale card system computers decided to look at tape systems, the resulting feasibility study took longer than the study of the original system. To determine if newer computers would do the jobs economically, utilities spent from three months (two companies with medium-scale systems) to two years (for a medium-scale and a large-scale system).

Combine Two Projects into One

Of the 14 companies in Group A, six conducted the feasibility and economic studies as one project. For large-scale systems, one company took eight months, three took one year, and one spent four years. The company with a medium-scale system spent six months to determine its feasibility and economy.

Services of outside consultants in the above studies were not deemed necessary by eight utilities of the 14. Of the other companies, two utilized consultant services to evaluate the feasibility only, one company gave the consultant primary responsibility, another assigned the consultant secondary responsibility, and one company utilized the consulting services of the computer manufacturers. Outside consultants were used for the first time by two utilities in studying the move from a card system to a large-scale system or to a tape system.

The experience of Wisconsin Electric Power illustrates a par-

ticular problem of the companies that first looked at computers. In 1954 WEPCo was faced with an increasing volume of accounts to be handled, on equipment with limited capacity which prohibited the refinement of procedures and the expansion to more mechanized routines. Six months prior to the start of a feasibility study, the company ordered the only medium-scale stored-program computer then available and in production. Then a six-months' study was made to determine the feasibility and economy of the installation.

More Systems Now Available

Some companies in Group B were faced with another problem—the greater number of computer systems, both card and tape, now being offered by ten or more manufacturers. This may account for the tendency of companies in Group B to devote more time to the selection of their particular computer systems.

Of the 12 utilities in Group B, five made separate studies of feasibility and economy. They spent from one to three years to determine the feasibility, and from three months to four years to determine the economy, the average for both studies being over a year. Two companies reported they were satisfied with the feasibility of computers, with one spending only one month to determine the economics of a transistorized medium-scale system and the other eight months on its study. The six companies making the two studies as one project spent from six months to two years, with one company spending 18 months after a four-month preliminary investigation.

Eight companies in Group B did not use consulting services in studies. Of the others, two retained consultants to verify the findings of their feasibility committees, and one to assist primarily in the economic determination. Three other companies turned the job over to consultants, while three made use of the consulting services of the manufacturers.

To make their own personnel more knowledgeable in the ways of computers, most companies in both groups took advantage of short study courses, seminars and schools offered by manufacturers. Personnel also studied equipment manuals and current literature. Seven companies in both groups reported they sent personnel to operating computers installations or the manufacturers' factories.

Two-Man Team Studies System

Both Consumers Power and Detroit Edison report they assigned two-man teams to study the proposed computer system offered by each interested manufacturer to work out the specific system, timing costs and estimates. Another company states that each major department, working independently, has the responsibility for the development of data processing applications affecting its own areas of operation.

Develop Definition of Computer

To give the manufacturers something to check their equipment against, it is necessary to develop a definition of the proposed use of the computer system. Companies in both groups are in general agreement that these elements should go into the definition: Functions of the application; input and output of each function; volumes of data to be processed; master records with frequency of occurence statistics; sample formats of input and output documents; and time sequence of functions.

Some companies add other elements to the definition, such as integration with other functions, complete diagrams of computer runs for each application, and clerical costs. One company in Group A added to its definition the requirement of processing gas and electric billings as one account.

In evaluating computer systems as proposed by the manufacturers, utilities in both groups reported on those features which should be studied carefully. These are listed in the accompanying table on page 66. However, this is by no means a complete list of all features or characteristics that should be considered.

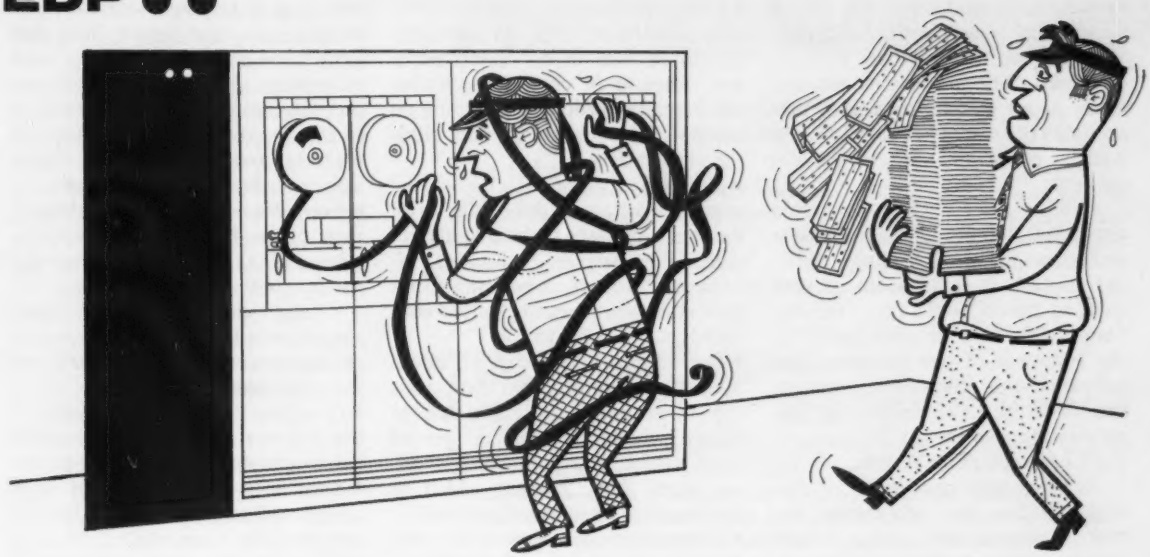
Consider Many Characteristics

For example, Ontario Hydro-Electric states that "altogether, 140 characteristics were identified and against each of these was set the manufacturers' formal specification." Evaluation of each characteristic was scored on a points basis. Detroit Edison points out that a thorough study of up to 100 factors affecting the choice of equipment then available led to the selection of the best all-around machine at the time.

Also listed in accompanying tables are the bases on which companies finally decided on a particular make of computer, as well as those factors that pertain to the manufacturer as an organization.

Choosing the Computer Manufacturer

Basis for Choice	Mentioned by Number of Utilities in Group A	Group B
Computer installed by other utility	6	6
Experience in data processing and electric utility field	10	14
Delivery lead time	2	3
Installation and training services	8	14
Free testing time	1	4
Back-up facilities at other installations	9	12
Guaranty of quoted price	1	5
Service after installation	5	..
Accurate information prior to delivery	1	2



First Application is the Biggest Hurdle

Conversion of customer accounting eases the way for future uses

● The primary objective of practically all companies in going to digital computer systems was to make customer billing and accounting a more efficient operation. Therefore, this was the first application to be made by most companies. In retrospect, most users will say that customer billing and accounting is by far the most difficult one to convert to the computer. However, once this application is made successfully, the worst is behind. Experience has shown that the lessons learned in putting customers "on the computer" can be translated directly into easier conversion of subsequent accounting and other operations.

The experience of ten companies in converting customer billing and accounting is shown in an accompanying table. Only four of these companies were able to convert the operation at or below the cost originally estimated. Another company, which converted about 67% of its accounts (centrally located) to a medium-scale machine in one month, found that costs were considerably over the estimate. When the remaining accounts were con-

Experience of Ten Utilities in Converting Customer Accounting

Number of Accounts	Length of Conversion	Accounts Converted per Working Day		Conversion Cost vs Original Estimate	
		Maximum	Average	Over	Under
2,000,000	19 months	10,000	5,000	300%	.....
310,000(1)	1 year	2,000	1,500	.....	0.06%
2,000,000	25 months(2)	6,000	4,000	Very close	
200,000	1 month	15,000	12,000	.....	20%
300,000(3)	18 months	2,000	865	90%(4)	.....
700,000	13 months(5)	4,000	2,700	10%	.....
170,000	1 year(6)	10,000	7,000	.....	.....
1,354,000	1 year	10,000	5,200	100%	.....
1,400,000	3 years(7)	4,000	2,000	"On the button"	
700,000	18 months(6)	4,800	1,850	Over estimate	

(1) 150,000 electric, 160,000 gas.
(2) To be completed April, 1960.
(3) 285,000 electric, 15,000 other.
(4) Subsequent conversion of payroll and stockholder accounting was done at estimated cost.
(5) Conversion from the present medium-scale card system to a medium-scale tape system will take four months for 740,000 accounts.
(6) Still in progress.
(7) Twelve divisions in the company were converted at the rate of one division per quarter. It is estimated that conversion from a medium-scale card system to medium-scale tape system will take ten months.

verted to a second computer, over a six-months' period and after a two-year interval, actual costs were as estimated. The first conversion was made at an average rate of 1,200 accounts converted per working day, with a maximum rate of 12,500 accounts.

Another utility, which converted about 100,000 accounts (large users and demand meter billings only), did the job in one month at very close to the estimated cost. Finally, "more difficult than anticipated" is the comment of one company that converted over 400,000 accounts in one day from an electronic machine accounting system to a medium-scale card computer system.

Reasons why conversion of customer billing and accounting was more expensive than estimated were reported by companies in Group A:

- Conversion costs about 300% over estimate were due to poor conditions of files to be converted, a low estimate of computer running time, training problems centering on computer programming, and clerical problems.
- Non-delivery of a high-speed printer, electronic difficulties with the first computer (subsequently replaced), inadequate manpower, inaccurate records, and difficulties with mark sense reading raised conversion costs considerably.
- For an operation covering about 300,000 accounts, conversion costs ran 90% above estimate due to higher than anticipated record transcription and field office training costs, plus features added to the program as it was developed.
- Conversion costs were 10% over estimate due to a longer conversion period than originally estimated.
- Operating time longer than that estimated put costs 100% over estimates. Unforseen operations, program complexities, refinements to the system, the need to establish controls, and coding change orders also contributed to higher costs.
- Conversion was more difficult than planned because of inexperience and a shortage of personnel familiar with the program.

Of the four utilities that reported actual costs better than or equal to estimated costs, three pointed out these reasons:

- Cost was 0.06% under estimate due to lower programming costs and the length (one year) of conversion.
- Shorter programming time than anticipated and an easing of physical requirements contributed to an actual cost 20% under estimate.
- By allowing three years for the conversion of over 1,000,000 meters, there was time to centralize operations and educate personnel. Actual cost equalled the estimate.

Utilities in Group B who still face the conversion of customer billing and accounting report these plans: Accounts ranging from 335,000 to 1,100,000 will be converted in 11-12 months; one utility with 270,000 accounts now is converting within one billing cycle; another company with 220,000 accounts will take three months, while a company with 1,400,000 accounts will do the job over 17 months.

Listed in an accompanying table are certain operations in customer billing and accounting that were centralized by Group A utilities following the installation of the computer system, or will be centralized by Group B utilities. In addition to these operations, seven others were reported centralized by one utility each in Group A: Preparation of opening and closing bills; order entry; premise history; dividend preparations; mailing of bills; bill punching; and revenue analysis. One utility centralized the mark sensing and punching of meter reader cards, but decentralized the preparation of these cards. Of the Group B companies, two reported they have centralized customer contact activities, such as service calls, accounting calls, and collection calls, and one will centralize customer deposits and stores records.

Most companies who converted

Functions Centralized After Computer Installation

Function	GROUP A UTILITIES: Previously Centralized	GROUP A UTILITIES: After Computer Installed — Cent.	GROUP A UTILITIES: After Computer Installed — Decent.	GROUP B UTILITIES: Previously Centralized	GROUP B UTILITIES: After Computer Installed — Cent.	GROUP B UTILITIES: After Computer Installed — Decent.
Cash posting	3	9	0	3	7	0
Past-due bills	3	8*	1	3	6	1
Cut-offs	3	6*	2	3	3	3
Accounts receivable	0	5	0	..	1	..
	Yes	No		Yes	No	
Credit procedures and cash posting mechanized	13**	0		12†	1	

* Review and mailing of past-due bills or cut-offs is decentralized by one company each.

** Credit procedures only partly mechanized by one company.

† Credit procedures and cash posting are mechanized only for headquarters division of one company; only cash posting mechanized for one company.

Who Controls the Data Processing Activity

Utility Office Reporting to	Number of Utilities
Controller	14
Asst Controller	2*
Treasurer	4
Asst Treasurer	2
Vice Pres—Finance	2
General Accountant, Manager of Accounting, or General Auditor	3

* Planning staff of the data processing group in one utility reports to the vice president for rates and economic research.

the customer accounting operation found that actual operating times were under-estimated ranging from 5% to 100%, with most times at least 15% longer than planned. Two companies provided more details on why actual running times are greater. Reported the first company, both the billing and the balancing runs conform to estimates, as does the special edit, but this operation needs reprogramming due to extensive revisions which reduce the speed on machines with magnetic drum memories. Overall time is greater than expected due primarily to scheduling problems which also multiply set-up times.

The second company reported these comparisons of actual operating times with estimates for these functions: Cash and order sort, and merge and edit equal to estimate; file maintenance and reading sort, 96% above estimate; billing calculation, billing separation, and file maintenance separation, all above estimate.

The experience of Commonwealth Edison in converting about 1,000,000 accounts to a large-scale computer points up the fact that additional work still can be done after the application is on the computer. Over 1,000 hr of program testing were expended prior to the actual start of conversion. After conversion was started, many additional hours were spent on program testing as "bugs" developed in the system. In addition, even though a system is operational, there are many improvements to be made as experience with the system is gained.

The company also reports that initially it required about 17.5 hr of operating time per day to handle 1,000,000 accounts. With customer accounting now on a more powerful large-scale system, operating time for almost 2,000,000 accounts is only 11 hr per day.

Once the billing and accounting operation was on the computer, many utilities launched into the conversion of other applications. With only three reported exceptions, utilities were much closer to estimated running times for these subsequent applications. For example, of four utilities who converted payrolls, one found the running time was 1.7% above estimate, three were on estimate, and one was 10% below. Applications of labor distribution, materials accounting, and distribution of equipment and transportation charges meet the estimated running times, and handling of stock dividends was 10% less.

The three exceptions were an add-on mechanization operation, 10% above estimate; revenue accounting, reported above estimate; and a cycle balance job, 100% above estimated time. One utility that put payroll, general stores, and depreciation on the computer as the first applications stated that actual operating time came within the general range of estimated time, even though changes were introduced into the programs.

Four companies offered solutions to problems that arise when additional operations are put on the computer. One reported they set up committee meetings and a short course on the computer to give accounting personnel a better understanding of the system's capabilities and to familiarize them with computer language. Conversely, programming personnel had to become familiar with accounting techniques and principles. Another company said that advance planning was necessary to provide proper scheduling and determination of priority of new applications with those already on the computer. Although conversion of payroll took only one week, one company offered that better communication and training will go a long way toward heading off "bugs" in the program, particularly those found in labor distribution. Converting the financial statement to the computer presented problems in developing the large program required (3,000 instructions), but the job was done successfully, reports one company.

Types of Hi-Low Checks Used in Computer Accounting

Fixed Formula

1. Multiply present use (if lower than previous) by constant, add another constant and compare with previous use, or (if present use is higher than previous) multiply previous use by constant, add another constant and compare with present use.
2. Based on an average of the last three months' use—used by two companies.
3. Estimated on prior use per day with fixed and percent tolerance (with heating adjustment for gas accounts).
4. 200% plus 10 kwhr or 20 ccf.
5. Compare with last two months' average use adjusted by multipliers and constants.
6. Based on previous period's use with 1,000 kwhr on the high side or with schedule minimums on low side.
7. Based on average of last 12 months' use and percent tolerance.
8. Compare with last month's use, past-year average use, and year-ago.
9. Twice the lower of previous month's or current use, plus 75 kwhr.
10. A fixed formula with several steps (under development).
11. Compare current use with previous month's use.
12. Compare with predetermined highs and lows for each rate.

Variable Formulas

1. Compare with previous month's use and adjust for weather changes.
2. Compare with average use times a seasonal factor.
3. Zero use on the low side; seasonal factor based on previous use on the high side.
4. Based on degree-days for heating accounts; adjustment factor based on previous use for regular accounts.

Other Types

1. Meter reader makes checks—used by two utilities.
2. No hi-lo check used by one utility.

Computer Operating Experience Covering

Company	Number of Electric Meters	Method of Meter Reading	Type of Bill Form	Data Processing System	Placed in Use	Major Applications	Special Applications
Arizona Public Service	164,322	Meter book (field testing meter box for printing indexes)	Laminated Post card	Rem-Rand Univac I 10 Tape Units 16 Unitypers 1 Moore Laminator 1 High-speed printer	2/57	Revenue Acctg; Payroll; Personnel Records; Dividends & Stockhldr Records; Cash Vouchers; Working Fund Drafts; Eng Studies	Costs from Payroll; Revenue History & Projections; Rate Case Data; Land-use Studies; Appl Saturation Studies
Cincinnati G&E	435,229 (738,732 gas & elec)	Mark sense card	1-side punch card (post card) 2 punched stubs	2 IBM 650 (card system)	4/56 (first) 12/59 (second)	Revenue Acctg; Revenue & Rate Analysis; Budget & Expense; Load Studies	.....
Commonwealth Edison	2,206,000	Mark sense card	Post card	IBM 705 III 2 TRC's, Magnetic Drum, 13 IBM 727's on main frame. 2 IBM 720 A's, 2 IBM 722's, 2 IBM 714's, 6 IBM 727's (tape)	1/56 (1)	Revenue Acctg; Plant Acctg; Eng Projects	.....
Con Edison	2,700,000	Meter book	Post card	2 IBM 705 II 4 TRC's, 3 IBM 720A's 3 IBM 720's, 3 IBM 714's, 3 IBM 722's	6/56	Cust Acctg; Payroll; Stores Acctg; Inventory Control	Preferred Stock Acctg
Consumers Power	890,000 (elec) 525,000 (gas)	Mark sense card	Post card	2 IBM 650 (third on order)	1/58 (first)	Cust Billing & Acctg	Appliance Saturation Survey; Customer Attitude Survey; Tax Refund; Load Research; Depreciation Studies
Detroit Edison	1,400,000	Mark sense card	Laminated post card	IBM 705 II 15 Tape Units Printer (1,000 lines/min) " (500 lines/min) IBM 650, IBM 407	4/55 (650) 3/57 (705 II)	Cust Acctg; Employee Data (includes Payroll & Dist) Eng Problems (on IBM 650)	Selected data for Adv, Appliance Surveys, etc
Ontario Hydro-Electric	550,000	Meter book, post card	Post card	Rem-Rand Univac II	8/58	Rural Cust Acctg	.....
Indianapolis P&L	248,000	Mark sense card	Post card	IBM 650 IBM 407 (on line) IBM 533 " IBM 523 "	12/58	Cust Acctg; Payroll; Matls & Supplies Exten; Transp Dist; Budget Comp; Ovhd Line Matl Closing; Annual Meter Analysis; Eng Problems	Insurance Program Analysis Forecast of Meters for Test; File Conversion; File Analysis
LA Water & Power	900,000	Meter book	Post card	IBM 650	1/58(4)	Payroll; Labor Dist; Dist of Equpt and Transp Charges; Expense & Budget; Matl Control; Eng Studies; Cust Billing	Payroll Statistics; Rate Schedules; Bond Sale Calc; Prop Tax Schedules
Northern States Power	840,000	Mark sense card, meter book	Post card	IBM 709	7/59	Cust Billing & Acctg	.....
Pacific G&E	1,900,000 (approx)	Meter book	Punch card in envelope	2 IBM 705 II, 4 TRC's and 32 Tape Units, 5 IBM 720A's, 3 IBM 714's, 2 IBM 772's	1/58	Cust Acctg	.....
Pacific P&L	285,000	Mark sense card	Pre-punched Post card	Burroughs Datatron 205 6 Tape Units, Cardatron with IBM 407, 523 and 089	7/57	Cust Acctg; Payroll; Eng Applications; Stock & Div Acctg; Rate Analysis	.....
Pennsylvania P&L	720,000	Mark sense card	Punch stub Post card	2 IBM 650	9/57 (first)	Cust Acctg; Payroll; Gen Matls & Supplies; Transp Acctg; Clearing Acct Dist; Eng & Op Studies	Deprec Studies; Opinion Surveys; Employee Fringe Benefits; Statement Calc; Const Budget Reports
San Diego G&E	316,000	Meter book	Post card	IBM 650	1/59	Cust Acctg; Payroll; Labor Dist; Transp Acctg	.....
Wisconsin Elec Pwr	650,000	Mark sense card	Post card	IBM 650	8/55	Cust Acctg; Accts Receivable; Revenue Analysis; Merch Acctg; Add-on Calc; Matls & Supplies	(See box on page 77 for 32 applications)

*Due to manual or machine errors.
(1) IBM 702 in-service date; replaced by IBM 705 II in 5/57.
(2) Includes 29.2 hr for operating time, 4.2 hr for setup, and 1.8 hr for conversion.
(3) Setup time normally runs 10.3 hr/mo; testing, 6.3 hr/mo; and scheduled maintenance, 22 hr/mo.

Many Applications Reported by 15 Utilities

Future Plans	Computer Use	Breakdown of Computer Use: Operating Time	Program Testing	Program Assembly	Idle Time	Rerun Time*: Manual	Rerun Time*: Machine	Unscheduled Maintenance	Total Computer Hours During Conversion
Revamp Payroll & Revenue Acctg; Transp Acctg; Plant Acctg; Energy Acctg; Better Revenue Forecasting	3 shifts; 6-day wk	Acctg-80 hr Other-23 hr	28 hr 5 hr		.....	.....	.....	.....	.....
Studying feasibility of large-scale computer for Cust & Gen Acctg	.....	Acctg-120 hr/wk Other-5 hr/wk	5 hr/wk	.....	.....	.....	.....	.....	.....
Oper Research; Labor; Stores; Stockhldr Records; Accts Payable; Gen Ledger; Payroll Acctg	3 shifts; 5-day wk with occasional added 1-shift 1-day use for spec. problems	Acctg—56 hr/wk Other—12 hr/wk	20 hr/wk 2 hr/wk	.....	4 hr/wk	2 hr/wk	12 hr/wk	3 hr/wk	Cust Acctg—Over 1,000 hr (702) Plant Acctg—Over 400 hr (705 III)
Utility Plant; Accts Payable; Journal Entry; Gen Ledger	3 shifts; 5-day wk (2 computers)	35.2 hr/day (2)	2 hr/day	.....	1.6 hr/day	1 hr/day	6.3 hr/day	1.9 hr/day	.....
IBM 7070 and 1401 Systems	.....	Cust Bill—61.3% Other—4.3% Rates & Econ—Stud—2.4% Load Flow—8.5% Other Eng—13.1%	0.29% 1.0% 0.8%		....	Not Major Item " "		5% 0.2% 0.2%	32 hr ....
Matls & Supplies Acctg; Plant Acctg; (IBM 705 III scheduled for 1/61)	2 shifts; 5-day wk (3)	Rev Acctg—272 hr/mo Emp Data—21.5 hr/mo	36 hr/mo	4.7 hr/mo	.....	10.2 hr/mo	15.5 hr/mo	3.7 hr/mo	.....
Materials; Inventory & Stock Control; Payroll; Labor; Gen Acctg	1 shift; 5-day wk	Acctg—50% Eng—20%	15%		.....	6%	9%		.....
Mechanize Install Orders; Stores Acctg; Property Records Acctg	1 shift; 5-day wk	Acctg—40 hr Other—40 hr	2 hr 2 hr		.....	.....	.....	.....	Acctg—50 hr
New Payroll & Cost Acctg procedures; Accts Payable; Plant Acctg; Monthly Budget	1 shift; 5-day wk	Acctg—20 hr Other—8 hr	7 hr 5 hr		.....	.....	.....	.....	Acctg—200 hr
Sharehldr Records; Stores Acctg; Gen Acctg; Plant Acctg; Payroll Acctg	1 shift; 5-day wk	Acctg—45.8% Other—7.9% (5)	10.5% 0.1%	0.7% 0.07%	11.1%	1.2% 0.3%	7.5% 0.3%	9.3%	.....
Stores Acctg; Payroll Acctg; Plant Acctg; other Gen Acctg	2 shifts; 5-day wk (2 computers)	Acctg—112 hr/wk Other—1.5 hr/wk	16.5 hr/wk		.....	.....	.....	.....	Acctg—1,712 hr (to 3/1/60)
Gen Acctg; Plant Acctg; Studying feasibility of additional or larger computer	2 shifts; 5-day wk	Acctg—78.3% Other—10.6%	1.2% 9.7%		.....	.....	.....	0.2%	Cust Bill—406 hr Payroll—138 hr Eng—1,630 hr Stockhldr—43 hr
IBM 7070 and 1401 (tape system) on order; Cost & Budget Control; Div & Stockhldr Records; Service Performance Statistics; Revised Payroll & Inventory Control	1 shift; 5-day wk	Acctg— 650 #1 20 hr 650 #2 39 hr Other— 650 #1 8 hr	2 hr ..... 2 hr	.... 4 hr	....	3½ hr	..... ½ hr	½ hr ½ hr	Acctg—250 hr Other—50 hr
Stores Acctg; Accts Payable; Engineering; Rate Studies	1 shift; 5-day wk	30 hr	2 hr		.....	.....	.....	.....	Acctg—500 hr
Large Cust (gas) Billing; Tape Systems Study	1 shift; 5-day wk	177 hr/mo	20.2 hr/mo	.....	.....	.....	.....	12.7 hr/mo (6)	Cust Acctg—56 hr (program testing off-premises)

(4) About 100,000 bills/mo, large users and demand meter billings only.
(5) Operating time, 34.4%; setup time, 11.4%; and scheduled maintenance, 5.3%.
(6) Scheduled maintenance, 8.4 hr/mo.

Personnel Problems Present Some

Employees should be told of the role the computer will play in the company. People for new jobs must be selected and trained

● One major objective of 15 utilities in going to a computer system was the potential savings in clerical personnel costs. Experience of 15 utilities with computer systems in operation shows that this objective

Selection, Testing, and Training of Personnel for Electronic Data Processing

Number of Personnel Selected From Within Company	Number of Personnel Selected From Outside Company	Depts Selected From	Methods of Selection and Testing	Correlation Between Tests and Personnel Performance	Minimum Requirements for Programmers	Length of Programming Course
All	None	All	Aptitude test, interview	Yes	Aptitude for programming	2 mo
Most	3(1)	Acctg	College entrance exam (2)	.....	.....	2 wk
All	None	Acctg	IBM programming test, 6-hr battery of tests given by consultant psychologist plus interviews	Very good	Good test results; no limit on age, sex, or experience	About 1 year (3)
All	None	All	Interview, IBM EDPM aptitude test, short Otis test, satisfactory completion of 705 programming course required	Fairly good	High school graduate, mark of B or better on EDPM aptitude test, completion of programming course	1 wk EAM 4 wk EDP
All	None	All	Aptitude test (combination of company and IBM), application review, two interviews, and interview by supervisor	High degree	High school graduate (two years of college preferred), good math background, knowledge of office and clerical procedures	1 mo
Most	Few(4)	All	Aptitude test, interview	Very good	High school graduate, math background helps	4 wk 4–5 wk(5)
All	None	3(6)	IBM programming test	Yes	Must pass programming test, knowledge of tab equipment, experience with company	10 days
Most	12	Most from Acctg	Aptitude test, evaluation by key supervisor	Yes	Mark in upper half of aptitude test, company experience essential	3 wk
All	None	Acctg	Supervisory judgment, aptitude test	Yes	Satisfactory completion of programming course	3 wk
Most	3	All	Past performance, aptitude test	Yes	None	2 wk
Most	1	Mach Acctg	IBM aptitude test, company test	.....	Four years of college, two year's experience in making systems, procedures and methods studies or in systems analysis development procedures for EDP equipment	2 wk
Most	11	Acctg	Personal interview, company record, IBM programming test	Yes	Logical mind, math, accounting or other suitable background	5 wk, 1 yr on-job training
Most	2(7)	Acctg	Business experience, good educational background, IBM programming aptitude test	Yes	College background and satisfactory mark on aptitude test	.....
Most	1	All	Company service, IBM EDPM aptitude test	Yes	Good company service record	4 wk
Most	4(8)	All	Interview, supervisor's recommendation, standard psychological exam	Rarely	Bach degree in Bus Ad, Math, or Eng	4 wk
All	None	Acctg	Background and potential capabilities (no formal tests)	.....	None	.....

(1) College graduates.
(2) From these tests can be gained an indication of where personnel may best fit in the company's development division of the methods department.
(3) Covers the entire range of punch-card equipment.
(4) Mathematicians for engineering operations on the computer.
(5) Four weeks at manufacturer's school; four-five weeks of company training.
(6) Machine accounting, methods, and general accounting departments.
(7) Computer personnel only.
(8) Because of lack of interested candidates with the required background.

can be attained. All 15 report they have reduced personnel in the areas directly affected by the computer. In addition, ten companies in the installation or planning stages say they will reduce personnel.

Also affecting personnel are other major considerations in adopting a computer system. In the order of importance as reported by companies in Electrical World's survey, these are: More work in the next three-to-five years than accounting department personnel could handle without additional help; rising salary costs; and problems of obtaining and holding accounting personnel.

Because a computer system will bring personnel reductions, new job assignments and procedural changes, it is pertinent to explore the approaches used by electric companies to prepare employees for electronic data processing. It might be expected that companies who first installed computers faced a more difficult problem, as there was little known about the equipment then, and therefore, a great deal to be feared by employees who would be affected.

However, only seven of 13 companies in Group A (those with at least one year of computer operation) reported they took special formal notice of the impending installation. Letters were sent by two companies to the office unions involved as soon as the decision was made to order the computer. Only three companies said they formally assured the employees affected that they would not be laid off, that they would be kept on in some capacity if a surplus developed, or that jobs and pay rates would continue.

One company sent a series of four letters to employees, the first going to the entire company at the time of the feasibility study. The second letter was sent to employees in the accounting group. A third letter, to the entire company, announced openings for programmers and reaffirmed the company's intention of continuing jobs and pay rates. The fourth letter was sent to the accounting group. The last two letters, from the general accountant and the personnel director, explained the steps to be taken in installing and operating the computer system. In addition, articles were included in the company magazine as work on the computer progressed.

Group meetings with personnel to be affected were held by one company, while another announced its intentions through supervisory personnel at various headquarters' locations and followed-up with individual meetings. A letter from the president to the employees was used by one company, followed by a minimum of 4 hr of EDP orientation for all company employees. Four utilities announced the computer's coming through articles in the company magazine, with one also holding supervisors' meetings and another using supervisory verbal notification. Two companies said they made no formal announcement.

Two Companies Use Meetings

Companies in Group B (those with less than one year's operating experience or in the installation or planning stages) generally are not making any special effort to prepare employees for the coming of the computer. Only two of 14 companies reported they held meetings to make the announcement. One held a luncheon for supervisors, followed by visits to those offices that would be affected primarily. Another set up meetings for employees and also used the company magazine.

Six companies ran one or more articles on the computer system in their employee magazine, with one of these companies also sending out a general notice on the subject. Two utilities said they announced the decision only to those employees who would be affected primarily. A letter from the vice president of accounting was used by one company, while another sent out a bulletin. No formal announcement was made by one company and another as yet has no plans for an announcement.

Greater effort was put into informational and indoctrinational programs for executive personnel, departmental managers and supervisory personnel by all utilities. Reported in greatest detail was the program of Consumers Power. In its divisions, managers and staff attended a 3-hr meeting covering all general aspects of the computer system, including a showing of the movie "Your Service Bill." Accounting superintendents and staff attended a 4-hr meeting covering general concepts plus overall accounting procedures and a showing of the movie.

The accounting superintendent and all personnel involved in customers' billing and accounting attended a 2-hr general introductory meeting covering forms and documents. These division personnel then were divided into 12 groups according to the type of work each would be performing. Meetings with each group detailed the work they will be doing under the new system. The final meeting for these groups

included a showing of the movie.

In a similar fashion, another company arranged a visit of personnel to a data processing center. Prior to the conversion of customer accounting, meetings with supervisory and clerical personnel in local offices explained the new forms and conversion procedures. Then a follow-up meeting was made to local offices six weeks after conversion.

An executive training course was held by one company for department managers and supervisors, with short courses for engineering groups, and special presentations for interested groups such as purchasing. This company also held voluntary night-school courses for 200 employees in four years.

Twelve companies reported they presented executive training courses, group meetings, seminars or orientation courses for department heads and supervisors, with some of these on a regular basis. Two utilities said that manufacturers' representatives demonstrated and explained equipment, with one utility having such meetings for top executives, business and engineering supervisors, and middle management.

Tours were arranged for supervisors of one company, with another using general literature on EDP for personnel. Two utilities said they presented very little formal indoctrination, while four reported no formal program used or planned as yet.

A major problem facing every utility is the selection and training of personnel for the computer installation. How companies with operating computer systems are meeting this problem is shown in the table on page 74.

Whether to upgrade personnel who have trained for a new job also must be decided. Of 23 utilities, 14 stated their policy is to upgrade, one said it will be, and eight reported they do not. However, upgrading is done by five companies only if the new job calls for a higher classification or rating. One upgrades personnel who become programmers or console operators while others generally not upgraded. One utility puts upgrading into effect retroactively for programmers who successfully complete their training.

To keep computer personnel informed of progress in the art, ten

EDP ● ● ● ● ●

Gear Policies and

Review current operations to make full use of the computer system. Take advantage of available time for additional uses

● The decision to install a computer system opens the door to great opportunities for savings for most utilities, but it is only the first step. For maximum utilization of this powerful data processing tool, it is necessary in many cases and desirable in all to make sure that contributing functions are geared to computer operation. In addition, as experience is gained in computer use, there will be many regular or special applications that can be put on the computer.

Many companies have taken a close look at their procedures and policies governing customer billing and accounting. One utility reported in Electrical World's survey that its "entire customer acccounting system was revamped and rebuilt from the ground up." Another indicated it overhauled its customer service organization.

Installation of the computer, noted one utility, was coincidental with a complete reorganization of customer billing and accounting procedures. Among the changes this company made are: Centralization of billing and accounting; adoption of mark sense meter reading; and mechanized re-entry and cash posting. Also, all aspects of former procedures were reappraised prior to adoption into the revised system.

Procedures that were changed by other companies with the installation of a computer system were:

- Modification of collection procedures, including a reduction in the number of special files and a move away from a highly departmentalized operation.
- Adoption of "centless accounting" on financial statements, use of "days in period" rather than "previous reading date", the estimating of the bill amount without "estimated readings", the use of formulas instead of individual judgements in hi-lo checks, as well as more rapid daily cash posting, and a history record instead of the meter reading book.
- Improvements in credit and discount policies, plus readily accessible data on prior billings.
- Elimination of individual review and calculation of accounts billed under complex provisions of rate schedules.

Installation of the computer system has or will allow these new procedures or policies to be put into effect, reported other companies:

- Availability of customer records 100% of the time, with continuous updating in major branch offices for the handling of customer inquiries in 1-2 min average against 10-15 min in the past.
- Revenue progression analysis now is available weekly.
- Accountability to the lowest level of supervision.
- Rigid control of input data with resultant pinpointing of the source of errors, plus uniformity in processing data and tighter control of entries.
- Standardization of customer accounting procedures throughout the company, with integration of collection notice preparation and a mechanized accounts receivable system.
- Simplified handling of collection stubs in local offices and elimination of the maintenance of unpaid bill records in local offices.
- Re-organization of all customer

of 21 utilities said they have formal programs. One company with three years of experience added a "definite yes" to the need for such programs. It holds monthly group meetings where new developments are explained. Personnel who will be directly affected have special meetings to cover a specific job being developed or under study by other computer users, with these personnel given the time to learn about the job first-hand.

Other formal programs consist of regular meetings, classes, or additional schooling. Personnel in these and other companies also attend industry meetings, study manufacturers' literature, subscribe to trade magazines or books, and attend equipment presentations.

One Company's Central Data Processing Organization

Group Name and Functions	Number of Employees
Data Controls and Scheduling	
Examining & Controls	8
Order Coding	22
System Control	16
Office and Staff	3
Data Planning and Programming	
Machine Methods	6
Program Development	12
Program Maintenance	13
Office and Staff	3
Central Data Processing	
Research & Systems Analysts	2
Staff	3
Machine Data Processing Dept	
Bill Preparation	11
Coupon Key Punching	23
Electronic Computers	12
General Key Punching	52
Machine Accounting	25
Key Punch Balancing	8
Record Processing	10
Office and Staff	4

Procedures to the Computer

contact activities into one area, such as service calls, accounting calls and collection calls.

Many companies are making time on the computer system available to several or all other departments. Time spent on the computer for non-accounting applications, said 16 companies, varies from minor amounts to 42% of total computer operating time. Ten utilities said this time amounts to more than 10% of the total, with one company estimating that 6,000 hr will be devoted to non-accounting applications this year. Another company uses the computer 4 hr per week for engineering problems.

What can be done on the computer is shown in the list of applications made by Wisconsin Electric Power Co. Among other companies, important applications most frequently noted are:

- In sales—Trends and forecasts, residential load factor studies, appliance saturation studies, customer opinion surveys, and rate analyses.
- In engineering—Load flow studies, network analyses, power plant efficiencies and other generation studies, fault studies, and pipe stress analyses.
- In other areas—Economic dispatch, rate case studies, and meter test statistics.

How Wisconsin Electric Power Co Uses an IBM 650 Computer System for Additional Applications

Regular and Recurring Applications

- Decoding cost codes to general accts
- Steam service billing
- Guaranteed line extension billing
- Meter test statistics
- Power plant efficiencies
- Material inventory reconciliation
- Material price comparison
- Material allow. quantity diff.
- Daily payroll and clearing account distribution
- Stockholder dividend and accuracy of statistics
- Mechanical constant audit
- Calculations of large primary, coal cost, unit price, bonus, auto allow. checks, payroll stepup rate, taxes

Special Applications

- Rate conversion tables
- Job evaluations
- Vacation and holiday accruals
- Meter reading bonus
- Industrial relations trend problems
- Wage survey
- Accumulation of meters by route
- Employee appliance survey
- Material usage report
- Property additions by service year
- Underground unit of property recon.
- Water heating studies
- Pension survey
- Mechanical apportionment of overheads to underground work
- Gen secondary-gen primary rate comparisons
- Accumulation of overhead services by tax district
- E. D. and power plant overtime report
- Calculations of unit pole costs, cut and fill, mortgage tables, overhead services costs, yearend payment, insurance, charity funds, seniority dates for power plant employees, union negotiation comparisons
- Analysis of unit of consumption, primary load, minimum bill, meter test sample, demand charges by end of block

EDP ●●●●●● Computer Manufacturers Offer

System	Basic Components	Cost Purchase or Mo. Rental	Application*	Mode of Input/Output Actual	Mode of Input/Output Adaptable to	Programming Aids Available: Accounting	Programming Aids Available: Engineering	Important Features
BENDIX AVIATION CORP								
G-15	Computer	$60,000 or $1,750 (average system)	Engineering, Scientific Statistical	KB, PC, MT, PT, LP	.....	.....	Micro-coding, INTERCOM Int & Com	Classed as medium-scale computer with additional peripheral equipment
G-20	Central Processor, Control Buffers Control Desk	Under $10,000 per month (for scientific use)	Data processing, Scientific	PT, PC, MT, LP	.....	.....	.....	Less complicated control desk; expandable memory
BURROUGHS CORP								
Burroughs 205	Central Processor Power Control	$135,000 or $3,900	250,000 accts Engineering	PC, PT MT, DK, LP	.....	Asm, A-M, Sim, Sub	Com, Asm, A-M, Int, Sim, Sub	Independent card subsystem; selective updating
CONTROL DATA CORP								
Model 160	Desk-size Unit	$60,000	Engineering & Scientific Calculations; Data Processing	PT, PC LP, TW	.....	Program Package	Program Package	Ease of programming
GENERAL ELECTRIC CO								
GE 210	Central Processor Tape Control, 6 Mag Tape Units, Document Reader, High-speed Re-entry Printer	$500,000 or $11,000 (minimum)	400–800,000 accts (40%)	DC, PC, MT, PR, PT, RPH	.....	Asm, Com, UR, GPR SMG	.....	Magnetic ink character reader; re-entry printer prints arabic characters in magmetic ink
INTERNATIONAL BUSINESS MACHINES CORP								
IBM 650 (card)	Control Console, Card-Read Punch, Magnetic Core	$182,400 or $3,750 (minimum)	200,000 accts; (3 hr/day) Engineering, Statistical, Scientific	PC	LP, PT	Program Libraries		Floating point; indexing registers; table look-up
IBM 650 (tape) and/or RAMAC 650 Data Processor	Control Console, Card I/O, Tape Control, RAMAC Storage	Tape: $506,600 or $10,775 RAMAC w/Tape: $630,900 or $12,400	300,000 accts (4 hr/day)	PC, MT PT	LP	"	"	In-line processing w/RAMAC; remote inquiry stations; floating point
IBM 1401 (card)	Central Processor, 1402 Card Read Punch, 1403 Printer	$149,300 or $3,180	100,000 accts (3½ hr/day)	PC, LP	.....	SP for utilities	.....	Stored program; alphanumeric, variable length core storage
IBM 1401 (tape)	Same as above plus 729 II or IV Tape Unit	$233,950 or $5,850	250,000 accts (3 hr/day)	PC, LP MT	.....	St Gen, SPS	.....	High-speed mag tape input/output
IBM 1620	Central Processor and Paper Tape Reader/ Punch	$74,500 or $1,600	Engineering, Statistical, Scientific	PT, TW	.....	.....	FORTRAN, SP, Program Libraries	Mag core memory; decimal; variable field length
IBM 704	Central Processor, Core Storage, Printer Card Reader	$1,994,000 or $44,000 (minimum monthly rental)	Engineering, Statistical, Scientific	PC, LP, MT, MD CRT	AC, CL, DD, PT, TW	Program Libraries		Core storage; floating point arithmetic
IBM 705 I	Central Processor, Card Reader, Card Punch, Console, Printer, 4 Mag Tape Units	$1,713,000 or $35,000 (minimum monthly)	500,000 accts (1½ hr/day) Engineering, Statistical, Scientific	PC, MT	.....	Autocoder, SMG, GUIDE, Program Libraries	FORTRAN,	Variable record length throughout; individual character addressing
IBM 709	Central Processor, Core Storage, Printer, Card Reader, 2 Data Channels	$2,630,000 or $55,200 (minimum)	900,000 accts (1 hr/day) Engineering, Statistical, Scientific	PC, LP MT, MD CRT	CL, PT, TW, AC, DD	Program Libraries		Core storage; floating point arithmetic; data channels; floating point trap
IBM 7070 (tape)	Arithmetic and Program Unit, Core Storage Control, Memory, I/O Control, Tape Control, Power Converter, I/O Synchronizer, Console, Punch, Reader, Printer	$900,500 or $20,350	450,000 accts (1 hr/day) Engineering, Statistical, Scientific	PC, MT	PT	Program Libraries		Random access storage; zero suppressor; scatter read-write
IBM 7070 (card)	Same as above less the I/O Synch and plus a Console Card Reader	.....	"	"	"	"	"	" "
IBM 7080	Central Processor, Console, Core Storage, Tape Control Unit, 4 Tape Units	$2,675,000 or $56,900	1 million accts (1½ hr/day) Engineering, Statistical, Scientific	MT	PC, LP, MD, TDS TR	Autocoder III Program Library	FORTRAN, Program Library	Simultaneous read-write of 5 mag tape units; 1.09 microsec cycle rate in central storage
IBM 7090	Central Processor, Core Storage, Printer, Card Reader, Data Channel	$2,880,000 or $64,000	Engineering, Statistical, Scientific	PC, LP MT, MD CRT	CL, PT, TW, AC, DD	Program Libraries		Data channels; data channel trap; automatic converting

Modes of Input and/or Output: Analog Converter—AC; Cathode Ray Tube Recorder—CRT; Communication Lines—CL; Direct Data Connections—DD; Decimal or Numerical Keyboard—DK; Document Reader—DR; Keyboard—KB; Line Printer—LP; Magnetic Drum—MD; Magnetic Tape—MT; Optical Scanner or Character Reader—OS; Paper Tape—PT; Photo Reader—PR; Punch Card—PC; Real Time Devices—RTD; Re-entry High-speed Printer—RHP; Tape Data Selector—TDS; Tape Record Coordinator—TR; Teletypewriter—TWX; Typewriter—TW.

Programming Aids: Assemblers—Asm; Auto-monitors—A-M; Compilers—Com; General Purpose Routines—GPR; Interpreters—Int; Report Generators—Rt Gen; Symbolic Programming—SP; Simulators—Sim; Sort Generators—St Gen; Sort and Merge Generators—SMG; Symbolic

These Systems for Utility Data Processing

System	Basic Components	Cost Purchase or Mo. Rental	Application*	Mode of Input/Output Actual	Mode of Input/Output Adaptable to	Programming Aids Available: Accounting	Programming Aids Available: Engineering	Important Features
MINNEAPOLIS-HONEYWELL REGULATOR CO (DATAmatic Division)								
Honeywell 800	Central Processor (4,096-wd memory)	$8,550/mo	200,000 accts (50%)	PC, MT, PT (manual via inquiry stations)	OS	ARGUS FACT 650 Sim	FORTRAN 650 Sim	Parallel processing; Orthotronic control; 16 simultaneous input/output channels
	Tape Control	2,000 "						
	4 Tape Units	3,600 "						
	Multiple Terminal Unit	1,950 "						
	High-speed Printer	1,950 "						
	High-speed Card Reader	325 "						
	High-speed Card Punch	490 "						
MONROE CALCULATING MACHINE CO (Litton Industries)								
Monrobot Mark XI	Central Processor, Console, Printer (TW), Punch Tape Reader, Tape Punch, Input Keyboard	$24,500 (monthly rentals to be announced soon)	5–10,000 accts (min); 25,000 accts (max) Statistical, Engineering, Scientific	PC, TW	PC, TWX, DK (1)	Being prepared		Compatability with virtually any input/output media; stores two usable program steps in each word
NATIONAL CASH REGISTER CO								
National Electronic Data Processing 304	Central Processor, Mag Tape Controller, Mag Tape Handler, Card Reader, Paper Tape Reader, Paper Tape Punch, High-speed Printer, Printer Converter, Multi-purpose Converter	$941,800 or $19,650 (minimum system)	300–400,000 accts (2) (45–55%)	PC, PT, MT (prepared off-line)	MT	NEAT, STEP, Com	STEP	Time sharing of read/write of mag tape; highest input speed; off-line capabilities using Universal Converter
PHILCO CORP								
Philco 2000	Central Computer (4,096-wd memory) 81 Index Registers, Input/output Processor, 7 Mag Tape Units, 3 Mod 280 UBC, 2 Printers, 1 Card Reader, 1 Punch	$1,494,000 or $38,200	500,000 accts (44%)	MT, PC, PT, LP	RTD, OS	TAC, St Gen, Rt Gen	ALTAC	Asynchronous logic; mag tape system with 90,000 char/sec transfer rate and ability to read backwards
RADIO CORP OF AMERICA								
RCA 501	503 Computer Program Control, Paper Tape Reader, Monitor Printer, Tape Selecting/Buffer Unit A (8 trunks), Power Supply	$257,000 or $5,400 $120,000 or	200,000 accts (50%)	PT (7 level) PC, MT	.....	Asm	Specific Routines	Building-block concept; true-variable length data items; simultaniety
	High-speed Storage	$2,400						
REMINGTON RAND UNIVAC (Sperry Rand Corp)								
Univac I	.....	$1,279,000 or $23,000 (3)	General purpose	PC, MT, LP, KB	.....	Flow-Matic	Math-Matic	.....
Univac II	.....	1,521,000 or 28,000 (3)	General purpose	PC, MT, LP, KB	.....	"	"	.....
Univac File Computer Mod 1	.....	500,000 or 12,500 (3)	Commercial data processing	KB, PC, MT, PT, LP	.....	Yes	Yes	.....
Univac 1105	.....	2,000,000 or 44,870 (3)	General purpose	PC, MT, LP, KB	.....	"	"	.....
Univac LARC	.....	6,000,000 (3)	General purpose	PC, MT, LP, KB	.....	"	"	.....
Univac Solid State 80 or 90 (card)	.....	347,500 or 6,950 (3)	General purpose	PC, MT, LP	.....	"	"	.....
Univac Solid State 80 or 90 (tape)	.....	500,000 (3)	General purpose	PC, MT, LP	.....	"	"	.....
ROYAL McBEE CORP								
LGP-30	Computer and Tape Typewriter	$49,500 or $1,100	Engineering Scientific Statistical	PT, TW	PC	.....	SPEED or ACT I, Int, DICTATOR POOL library	Large memory; ease of programming
RPC-4000	Computer, Tape Typewriter System (2 units)	$87,500 or $1,750	Engineering Scientific Statistical Accounting	PT, PC, LP, TW	.....	.....	.....	High speed access to "extra-large" memory
RPC-9000	Computer, Tape Typewriter System, Mag Tape Drum (3 units)	$125,000 or $2,500 (approx.)	Business Data Processing	PT, PC, LP, TW	.....	.....	.....	"in-line" data processing; true random access to mag tape memory

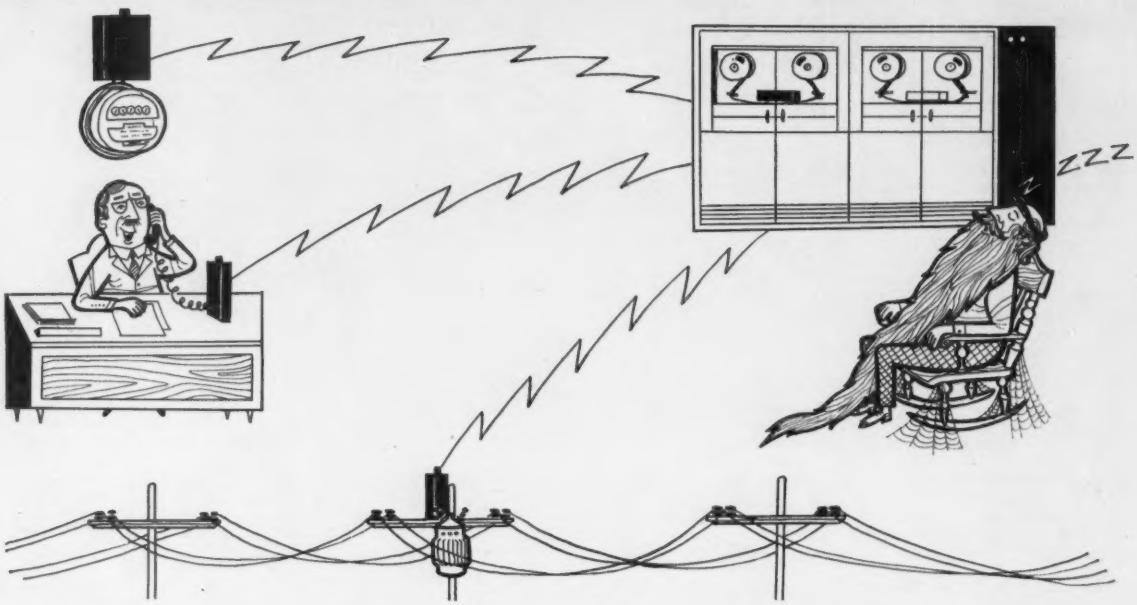
Program System—SPS; Utility Routines—UR.

* Minimum number of customer accounts for economical accounting application. For the number of accounts listed, customer billing and accounting is the primary application, assuming a 5-day cycle, 20-day month, 1-shift operation, monthly billing and use of mark sense cards. Time available for other work ( ) might include accounts payable, property accounting, payroll or engineering applications.

(1) Computer is adaptable to virtually all machine languages now in use.

(2) Assuming that all printing of bills is off-line, about 45-55% of 1-shift time is available for other work.

(3) Approximate or minimum price.



Computers May Integrate All Data

● There is "no foreseeable limit" to the use of electronic data processing by electric utilities for accounting, management, sales or engineering applications, reported one company in Electrical World's survey. Another said the "ultimate goal" is a company-oriented computer system to make immediately available to management all controls needed to run the company.

From the limited amount of basic and internal data already being generated by any utility and from external data, said another company, the computer will synthesize the date to produce reports in the best possible form to aid in management decisions.

Utilities took advantage of the survey to report what additional, new or different equipment is needed or desired for the near future. A desire for more accurate or perfected character sensing devices was indicated by 13 utilities. Ten companies said bigger and faster random access memories are a major requirement.

Teletransmission of data is a feature wanted by seven companies. Ontario Hydro-Electric Power Commission already is using existing wire systems to transmit data for its rural customer accounting application. One utility noted the need for low-cost satellite printers at district offices but operated from a central computer. Three others want remote interrogation of the central file.

Six companies listed faster printers and four suggested direct access by voice to computers. Language compatibility among computers was reported by two utilities. Need was also reported for better input/output devices for real time data processing, more self-checking and self-correcting data handling facilities, and less costly maintenance.

How soon these hopes and desires of the industry might be transformed into realities can be judged from comments offered by manufacturers:

●● Major emphasis will be on making computer systems easier to use, said Burroughs Corp. Chances are good for the development of a common language, plus dramatic advances in film and chemical memories.

● Input-output systems will more closely approximate the speed of the central processor and character recognition input devices will be scanning coded documents. There also will be a greater tie-in of data processing with point-of-origin sources.

●● Within five years punch cards will be obsolete in utility billing, said General Electric Co, having been replaced by magnetic ink character recognition or a similar system readable by people and machines.

●● The next ten years will see as great an impetus in the computer field as was recorded in the Fifties, but the emphasis probably will change, stated International Business Machines Corp. The coming computer generation is more likely to be a family of special purpose machines designed for specific problems.

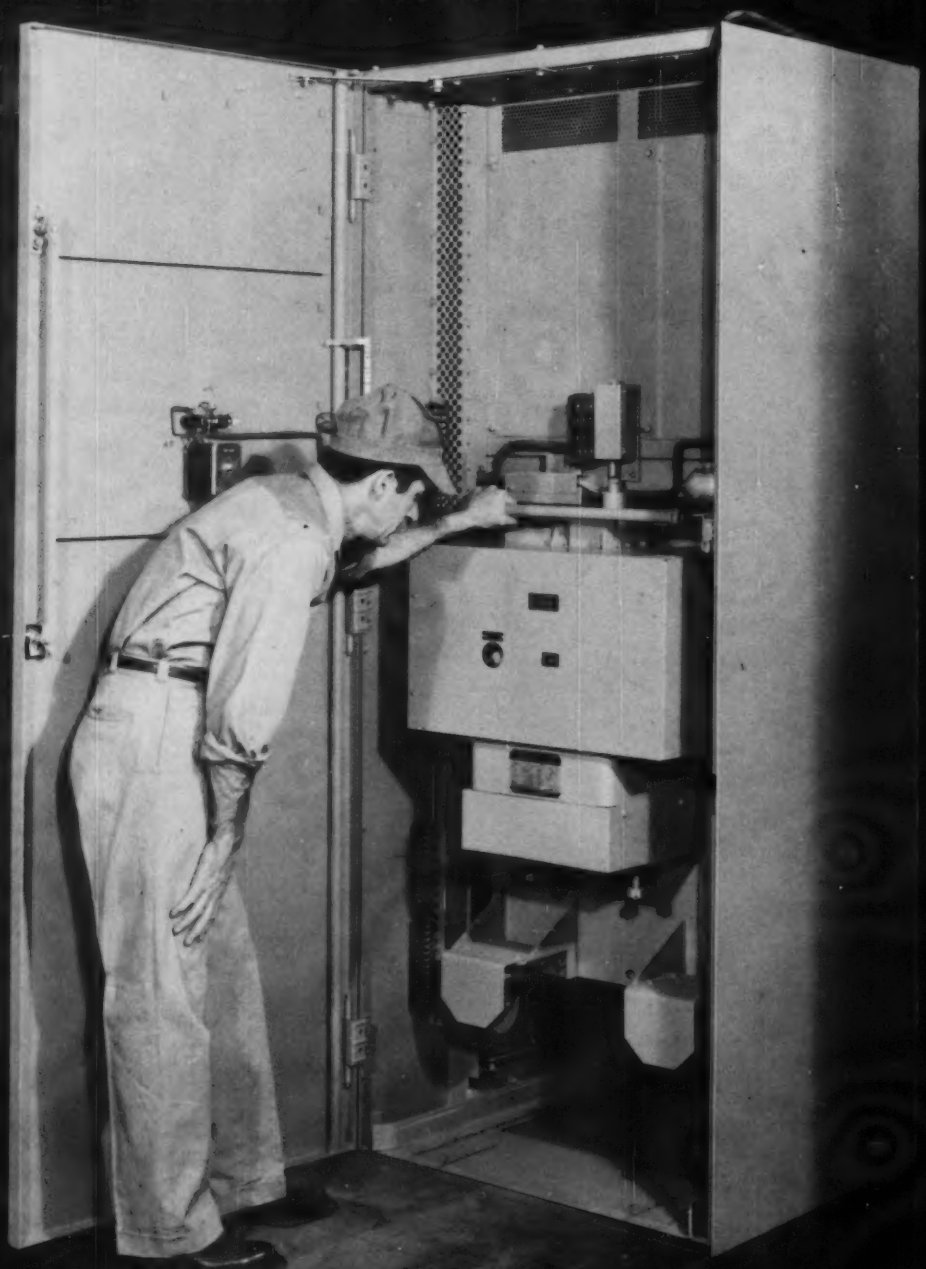
●● Size of data processing equipments will continue to decrease, RCA reported. In the next five-ten years, a 3:1 size reduction is expected, the same as was achieved in the last five years. The stage in design and manufacturing is being reached where reliability of operation will not be a problem.

● A long-range objective will be the automating of the communication chain-of-command from the primary source to the data processing system. Five years hence, users will be buying "systems," not units of equipment.

●● Computer service centers will make it practical and economical for smaller utilities, including municipals and rural cooperatives, to take advantage of computer methods, said Remington Rand Univac. This service center will mechanize most of the work, including automatic rate selection and calculation of extensions.

Change hats
with your maintenance man, he will demonstrate...

WHY GENERAL ELECTRIC
MANUFACTURES ONLY *Vertical Lift*
METAL-CLAD SWITCHGEAR



Follow these
3 easy
inspection steps

GENERAL ELECTRIC

General Electric manufactures ONLY Vertical Lift Metal-clad because...

General Electric's exclusive *Vertical Lift* design gives you superior switchgear performance... these operational benefits

1 Visible circuit breaker safety protects your personnel — helps prevent wasteful outages

General Electric Vertical Lift is the only switchgear design which allows your operator to actually *see* when the primary disconnects are parted . . . a safety bonus that also reduces the possibility of costly equipment outages.

Safety you can see is a prime reason why General Electric manufactures Vertical-Lift design Metal-clad switchgear.

2 One minute contact inspection saves you costly maintenance time

General Electric Vertical Lift design lets your maintenance man expose the contacts in just one minute for cleaning, inspection, and adjustment. This efficient maintenance reduces your operating expense. Quick, easy contact servicing that contributes to the over-all economy of General Electric Metal-clad installations is another reason why General Electric manufactures Vertical Lift design switchgear.

3 Up-front location of operating mechanism cuts your installation, maintenance costs

G-E Vertical Lift design gives you another cost saving through placing the breaker operating mechanism and controls up front. Even the stored energy operating mechanism is mounted up front for easy access, reducing maintenance time and expense.

4 20-minute routine maintenance means less service man-hours — more productivity

Under normal conditions, your maintenance man can remove G-E Magne-blast breakers from their housing, give routine maintenance, and return them to service in 20 minutes. General Electric's exclusive Vertical Lift design contributes increased switchgear efficiency —in both operating and maintenance phases—to your Metal-clad switchgear installation.

5 Magne-blast circuit breaker action gives you effective system protection

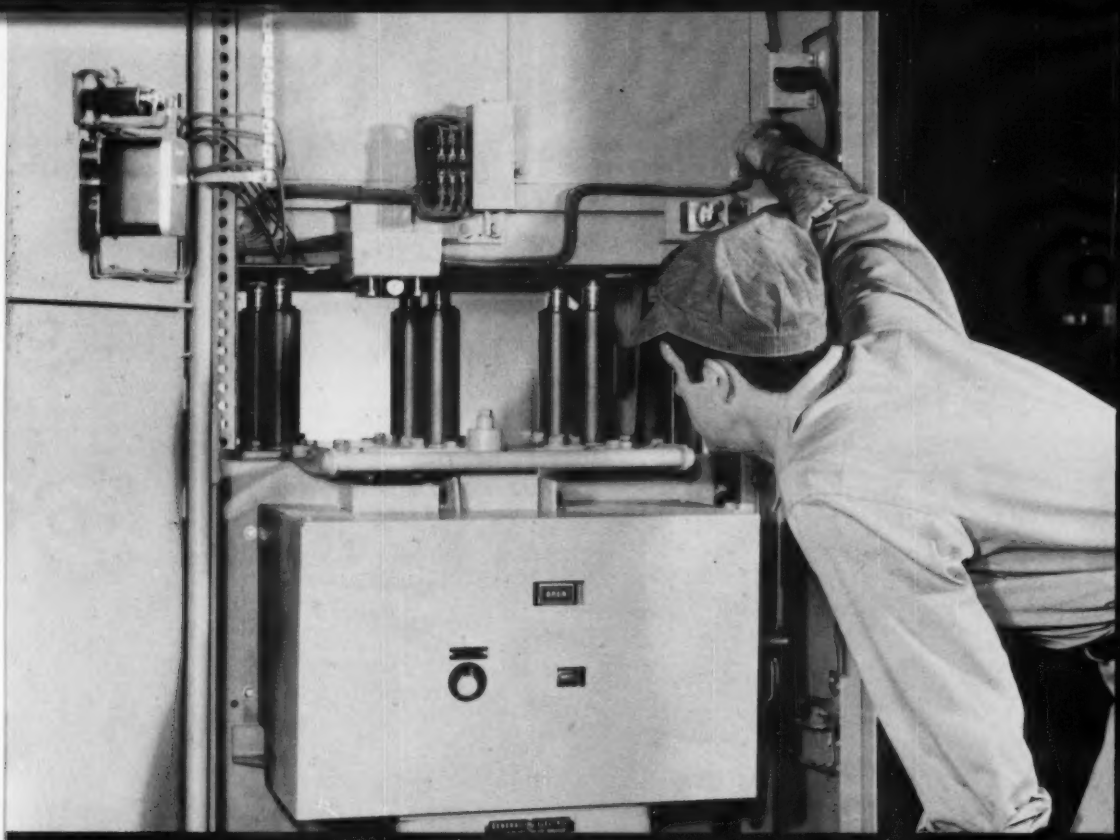
General Electric's Magne-blast breaker design gives you positive, three-phase interruption and fast, clean arc extinction — a combination that assures high reliability, top switchgear performance. Extensive factory quality control, and testing at full-rated interrupting capacity maintain the uniformly high operational standards of G-E Vertical Lift Metal-clad switchgear.

Both General Electric assemblies and Magne-blast circuit breakers are shipped completely assembled. This service feature results in greater safety for personnel and reduced installation time and expense.

G-E Metal-clad is available in voltages from 4.16 to 13.8 kv, and in interrupting capacities from 75 to 1000 mva. This full range of voltages and capacities enables you to select switchgear "tailored" to your present or projected system needs . . . yet you pay no premium for special engineering or construction, thanks to many conventional ratings.

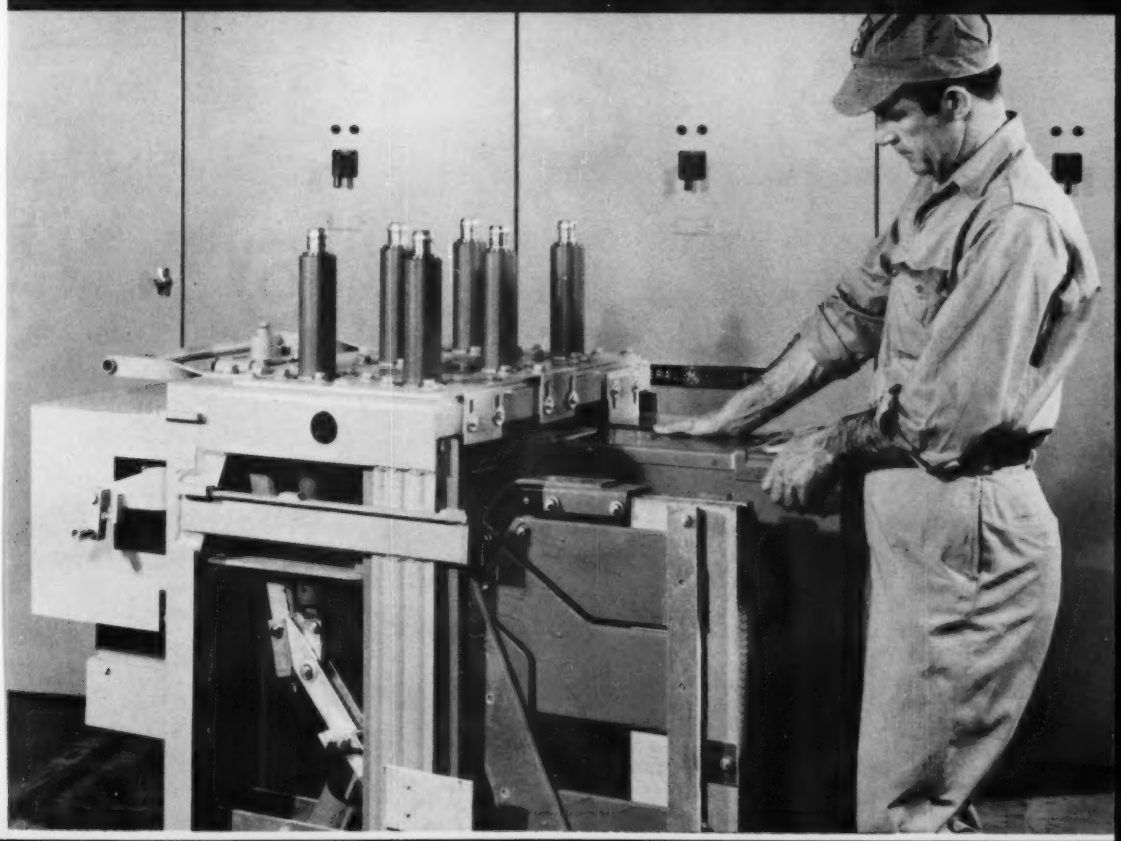
FOLD OUT FOR STEP 3 ▶

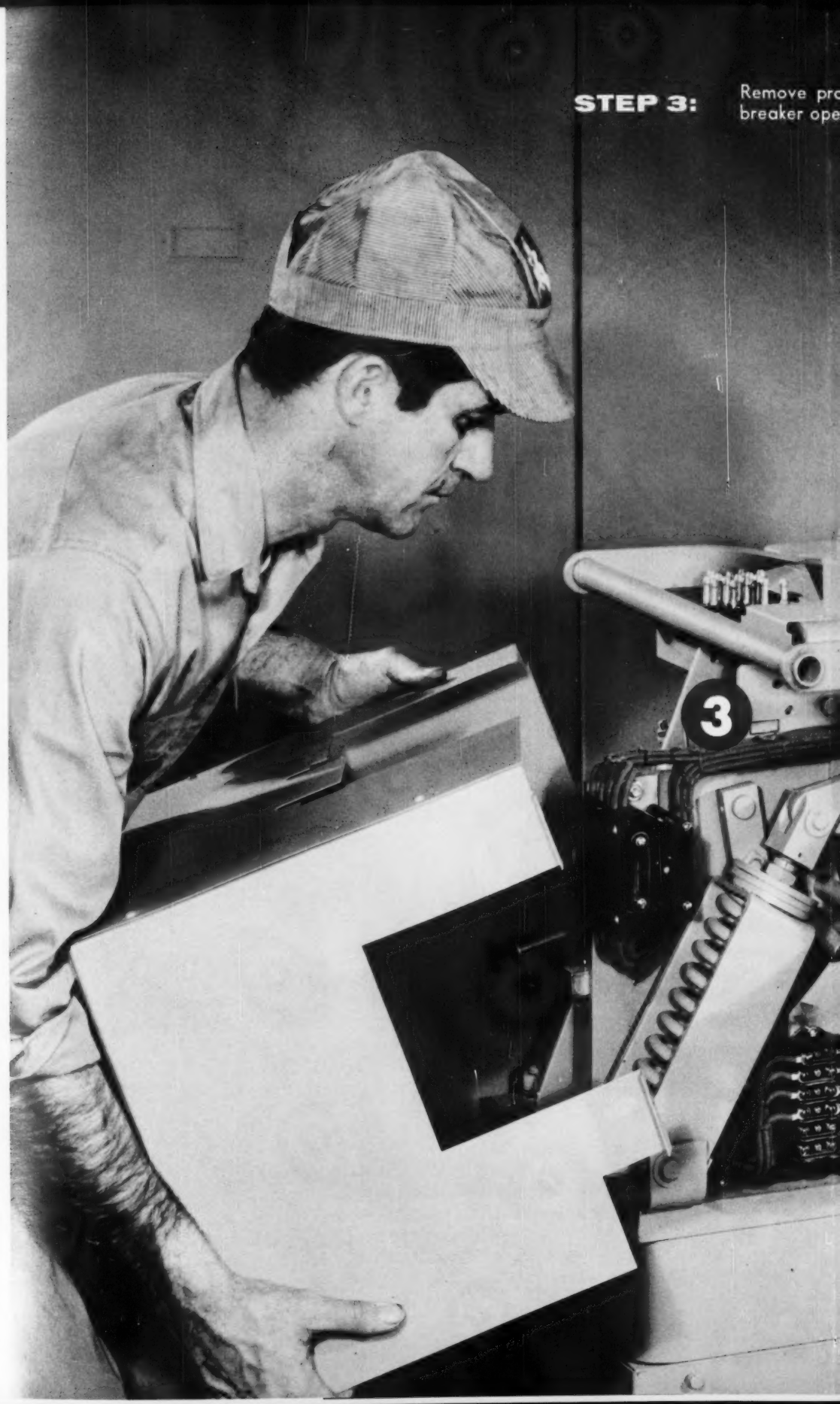
GENERAL ELECTRIC



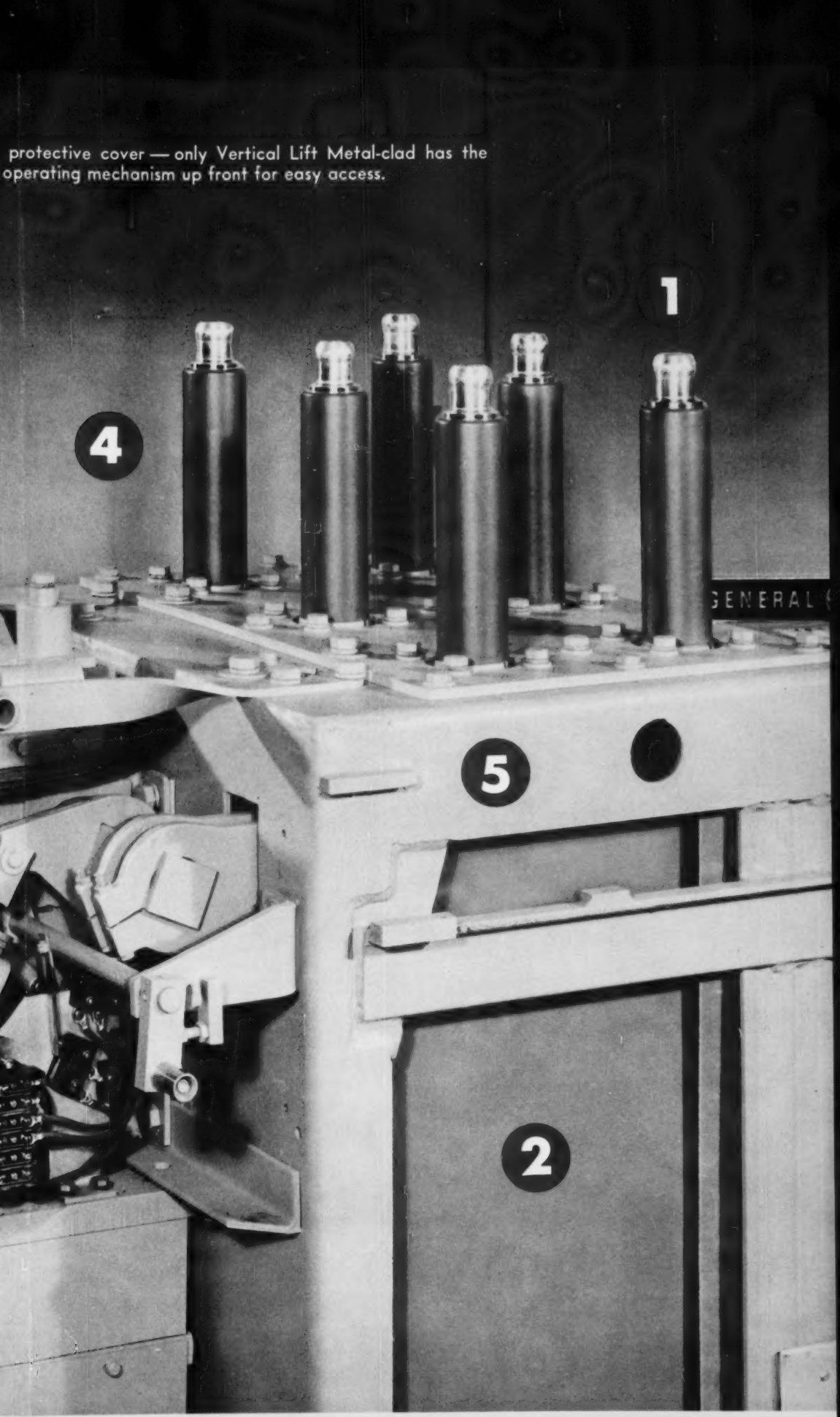
STEP 1: Disconnect breaker automatically—only Vertical Lift design permits operator to actually see when disconnects are parted.

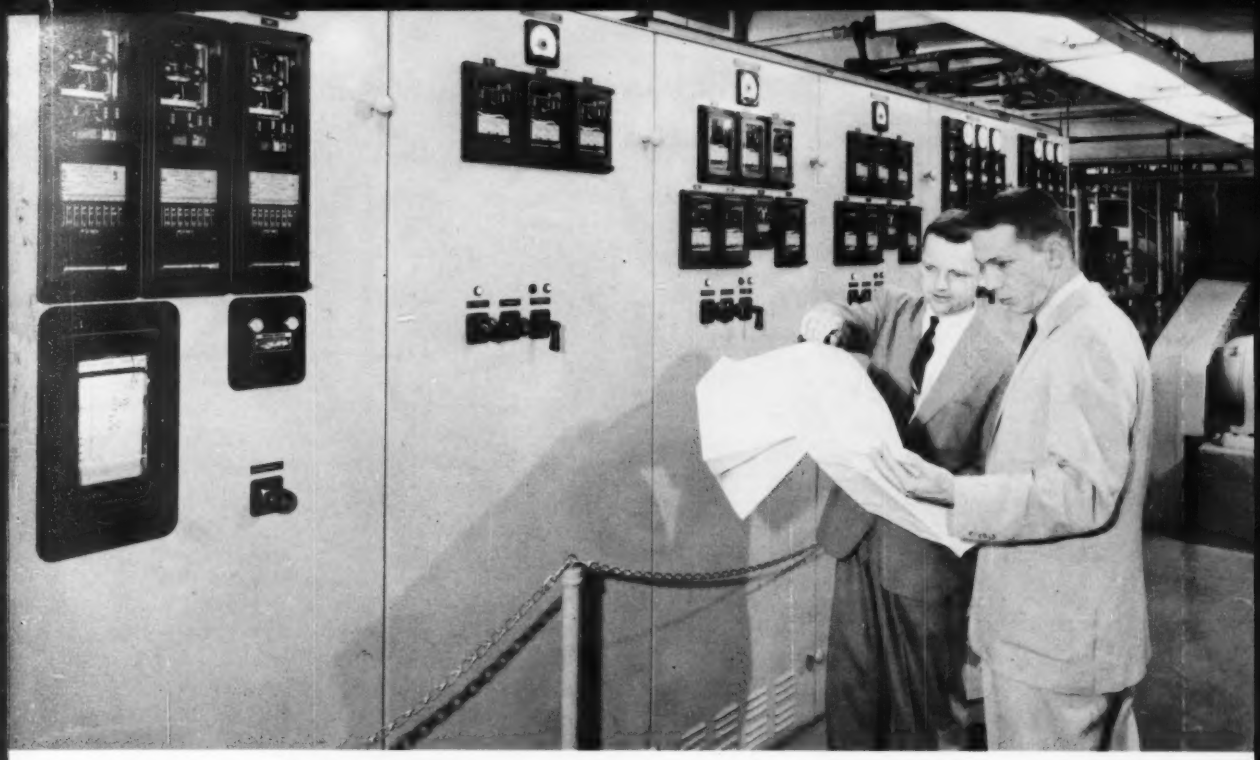
STEP 2: Remove breaker, box barrier — Vertical Lift design allows operator to inspect contacts without removing arc chutes.




STEP 3:
Remove pro
breaker ope
3

protective cover — only Vertical Lift Metal-clad has the operating mechanism up front for easy access.





In addition to exclusive design features...

G-E application and service engineers pre-engineer your Metal-clad switchgear installation... give continuing service

The first step in the extensive service you receive with General Electric Metal-clad switchgear is the expert problem-solving and planning assistance from your G-E sales engineer.

Next, G-E application engineers study your system, offer suggestions for efficient, economical installation, and monitor project progress.

G-E guide-form specification sheets simplify the ordering of Metal-clad switchgear units — your engineering expenses can be reduced through the use of this General Electric system planning assistance.

When necessary, your Metal-clad equipment is inspected and test-checked at the time of installation to assure a satisfactory hook-up to your power distribution system.

When you plan a new or expanded system, call in your G-E sales engineer early so that he can give you maximum assistance in satisfying your switchgear needs. Write for this detailed switchgear bulletin — GEA-5664E, to Section 511-36, General Electric Company, Schenectady 5, N. Y.

Contact your General Electric switchgear representative for more information about your best buy — G-E Vertical Lift Metal-clad switchgear

Progress Is Our Most Important Product

GENERAL ELECTRIC

Clean Insulators With Washer 'Gun'

DARYL E. GAIENNIE, Assistant Supt of Transmission and Distribution, Savannah Electric & Power Co, Savannah, Ga.

An insulator washer designed and built by Savannah Electric & Power personnel has helped to eliminate flash-overs due to insulator contamination at major 44-kv substations. Weekly use of this washer has replaced manual cleaning of substation porcelain. This manual method was lengthy, tedious and expensive, and required that loads be transferred.

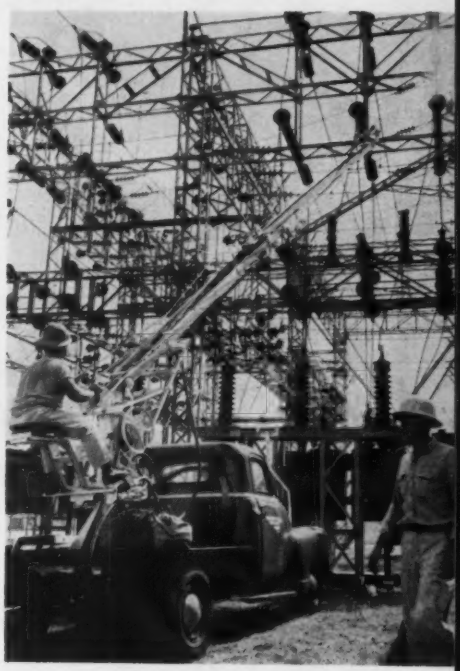
A gasoline-driven piston pump mounted on a trailer is capable of producing 700-psi pressure through a ¾-in. high-pressure hose and the washer "gun." The base for the "gun" is the pedestal assembly from a manually controlled hydraulic ladder converted to electric hydraulic.

The "gun" is an extension-ladder type of boom 32-ft long with the upper section 6-in. wide. It can be elevated about 75 deg from the horizontal; the entire unit rotates 360 deg with the operator in place. The boom, insulated from the bottom section by wood dielectric and polypropylene rope, is controlled from the base by a sheave and line.

A hand wheel on the right controls vertical movement, while one on the left controls horizontal motion. The "gun" uses a running-thread-and-stop for horizontal motion 40 deg to either side of center.

High-pressure hose from the pump and tank trailer connects to the "gun" through a foot-operated valve on the pedestal and thence up the boom. Washing solution is discharged at the boom tip through a hard-centered disc. The truck bed and base are grounded to the station ground through flexible cable.

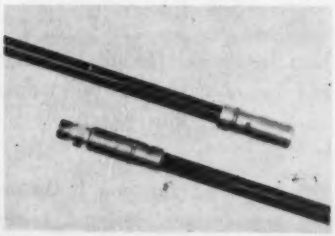
In substations that have been washed weekly, there has not been a flash-over in 15 months of operation. In one station where washing was delayed three weeks, there were several outages in a 48-hr period.



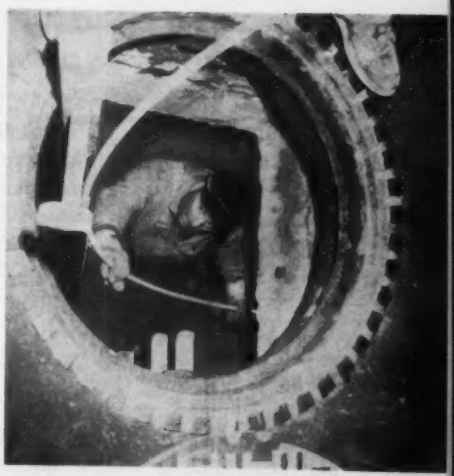
CHEMICAL CONTAMINATION on insulators in 44-kv substations is washed off weekly with mobile rig

Pull Underground Cable With Glass Rods

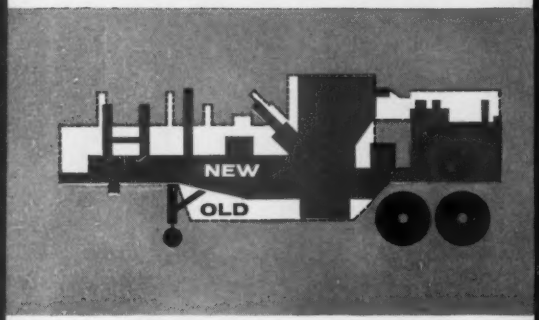
Insulated cables are being installed in underground ducts by crews of Consolidated Edison Co with the help of interlocking sections of Fiberglas duct rods. These rods in sections up to 10 ft are connected and fed through the ducts from one manhole to another. The flexible non-conducting rods can negotiate turns and angles easily.



A double male nipple provides a positive and quick coupling and uncoupling connection. Made of FF-S ⅜-in. steel with a ¾-in. hex, it connects to the rod by female ferrules constructed of ¼-in. standard brass pipe. The ferrules are double-crimped to withstand a 3,000-lb tension. Rods are made of reinforced Fiberglas strands and are about ⅝-in. diam. Designed by Consolidated Edison engineers, the duct rods are supplied by Fredricks Co.

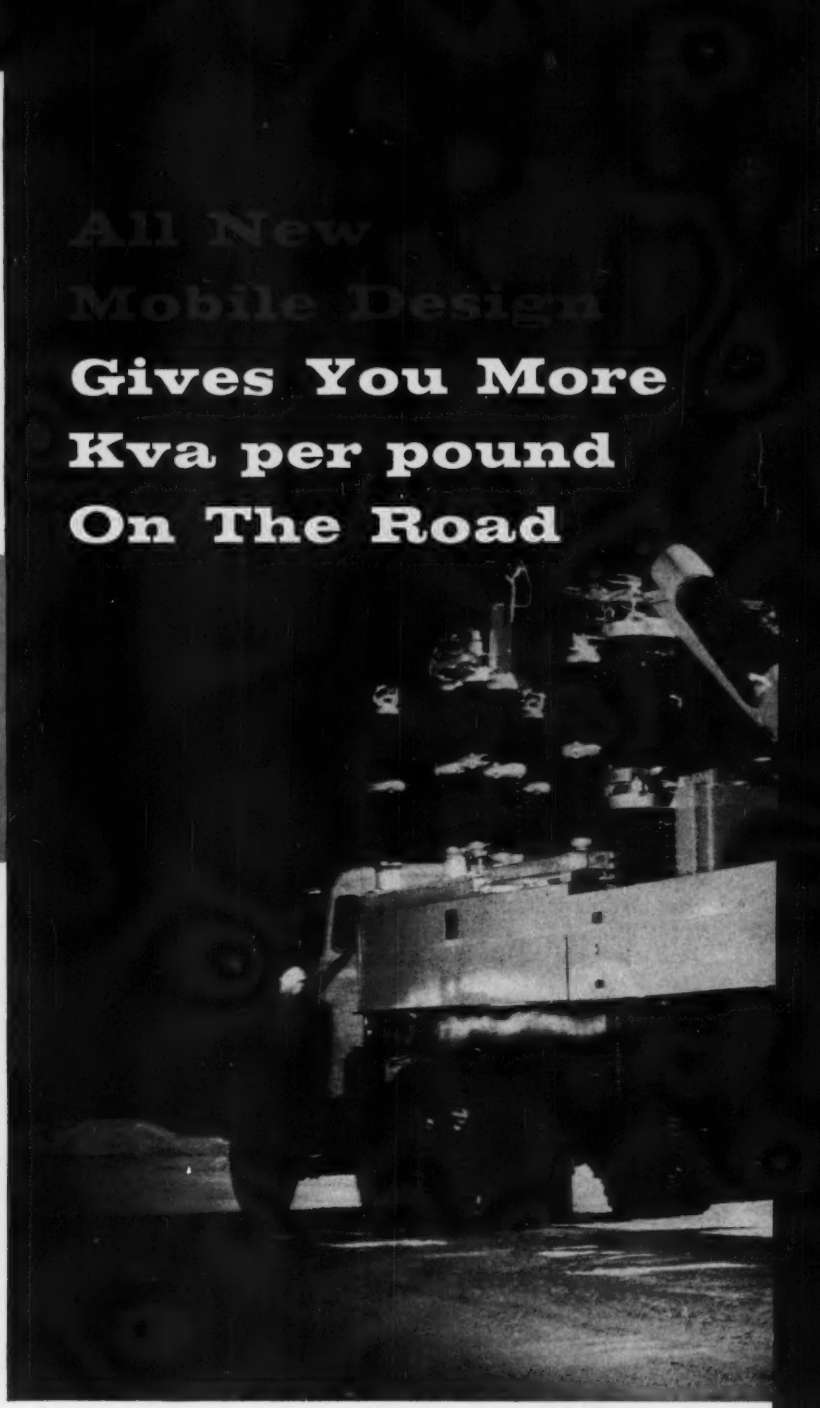


General Electric
Mobile Substations
and
Mobile Transformers



Higher capacity, lower weight of General Electric mobile units open new areas for savings and service to utilities.

All New Mobile Design Gives You More Kva per pound On The Road



- **Reduces Investment in Unused Capacity**
- **Cuts Operating Cost**
- **Improves Customer Service**

Dramatic improvements in General Electric mobile substation and mobile transformer designs now make possible far more kva per pound on the road than ever before. Complete mobile substations rated up to 20,000 kva, 115 kv and mobile transformers up to 40,000 kva, 138 kv are now available from General Electric. Typical of these units is the 17,000 kva, 115 kv substation shown above.

Progress in Design

A 705 computer cuts engineering time, while determining the optimum transformer design in all areas of consideration such as cooling, insulation, size and weight —whatever the kva and voltage rating requirements.

New straight-beam trailer provides a lighter, stronger unit.

Simplified low-voltage switchgear with a 5-cycle, outdoor-type circuit breaker reduces weight, speeds interrupting time.

Use of Formex* turn insulation for all windings rated 350 kv BIL and below permits safe loading beyond the normal 55 C rating, thus effectively increasing the available kva.

Progress such as this pays off for you in better mobile substation and transformer designs, faster delivery . . . and the most kva per pound on the road!

Economical System Operation

Enjoy savings in many ways from these flexible utility tools. For instance, a G-E *mobile substation* can bypass a complete permanent substation permitting planned maintenance during regular hours with no loss in service and with increased safety to personnel. Careful scheduling means higher-quality maintenance.

System changeovers can be made quicker, more economically, and without service interruption. New loads can be picked up immediately.

Mobile transformers can help reduce your investment in spare capacity! They can provide the necessary back-up protection for emergencies at far less cost than spare stationary transformers or underloaded transformers. All stationary units on the system can be put in service and loaded to capacity.

These are only a few of the ways your utility can profit with General Electric mobile substations and mobile transformers. Get the full story from your G-E Apparatus Sales Office; or write Section 422-44, General Electric Co., Schenectady 5, N. Y.

* Registered Trade-mark of General Electric Co.

GENERAL ELECTRIC

Procurement & Products

COAL ▶ **Coal makes strong bid to hold its own** in eastern utility markets. Prices negotiated with utilities hold at same level as last year, and reduced freight rates will continue in effect with ICC blessings. These conditions put coal in position to compete hard with oil and natural gas—the two fuels that have been gaining in the prize utility market.

OIL ▶ **Interior Dept's announcement that it will hold oil import quotas** for six months to the ceilings set earlier was further good news for the coal men. Oil imports during January and February were running at record rates, using up a sizeable share of the six-month quotas.

FLY ASH ▶ **Five-year project to set standards for using fly ash** in secondary road construction is being undertaken by the University of Illinois. Prof George W. Hollon will direct the search for information to develop a design method and set construction standards for using both fly ash and wet-bottom boiler slag. A miniature highway test tract is being built for use in the experimental phases of the project.

SUPPLIERS ▶ **RT&E Corp will open new distribution transformer plant** at Arlington, Texas, about June 15 in a continuing expansion program. The firm presently operates manufacturing facilities at Waukesha, Wis., and Portland, Ore. . . . Motorola Communications & Electronics, Inc, establishes sales and service headquarters at Fair Lawn, N. J., to serve 15 eastern states and the District of Columbia.

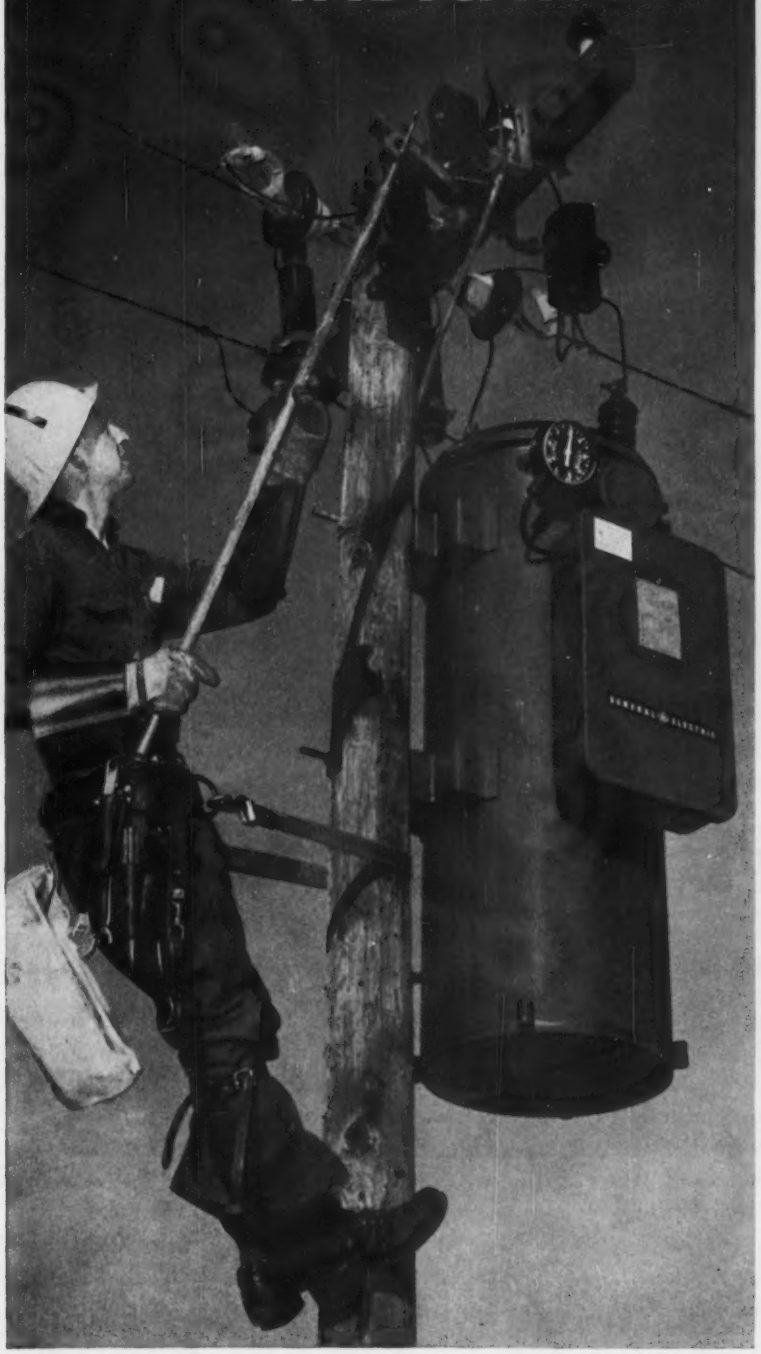
LABOR ▶ **Outcome of the union elections held March 25** at General Electric's Lynn and Everett (Mass.) plants could be significant in appraising future labor negotiations in the electrical manufacturing industry. Present contracts with IUE (International Union of Electrical Workers) expire in October for both Westinghouse and GE. The Lynn election (which hadn't been held as EW went to press) was a test of strength between the IUE and the insurgent UE (United Electrical Workers) to see which would act as bargaining agent for the 8,000 workers at the two GE plans. A substantial majority for IUE would strengthen the union's hand in the coming negotiations, but a win by UE would weaken IUE. In tough in-fighting during the two weeks prior to the election, two of IUE's top local officers resigned to join up with the UE.

QUOTE ▶ **Today's quote:** "A Purchasing Agent starts out knowing practically everything about everything, but ends up knowing nothing about anything—due to his association with engineers and salesmen."

News of Manufacturers ..... page 94
New Equipment ..... page 102
Readers Service ..... page 107

ANOTHER STEP AHEAD IN VOLTAGE REGULATION

POSITIVE NEUTRAL INDICATION



NEW

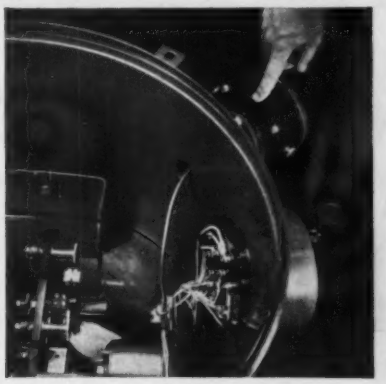
Mark-II position indicator for G-E voltage regulators protects lineman and equipment

Exclusive Mark-II Load Bonus position indicator and indicator drive system for General Electric single-phase step voltage regulators provide positive indication of tap-switch position. This gives more assurance against fear of injury to personnel or equipment when bypassing regulators on hot lines.

Linemen are aware that if a regulator is bypassed with the tap-switch off neutral position, the dead short created across part of the series winding can destroy equipment and seriously endanger the lineman.

It is important that operating personnel *know* that regulators are in the neutral position before bypassing. The new General Electric Mark-II Load Bonus position indicator provides this assurance.

New Mark-II position indicator system—standard on all G-E ML-32 regulators at no price premium—is an example of General Electric's continuing leadership in voltage regulators. This is another reason why G-E regulators cost less on the line. Ask your regulator representative for more information. General Electric Company, Schenectady 5, New York. 423-43



NEW MARK-II INDICATOR drive system eliminates possibility of indication error. Unique locking coupling and gear-driven indicator assure positive alignment of indicator hand and tap-switch position.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NOW YOU CAN GET SAFER, FASTER, LONGER-LASTING

Anaconda Durasheath has a new clean-stripping, semi-conducting tape

The megohm meters (above) are measuring the surface resistivity on two samples of high-voltage, rubber-insulated, Shielded and Neoprene-jacketed cable immediately after the semi-conducting tape has been removed. The sample on the left (with a megohm meter reading in excess of 100 megohms) is Anaconda Durasheath incorporating the exclusive clean-stripping, semi-conducting tape. For comparison, the cable on the right with a low reading typifies old-style cable manufactured without semi-conducting tape.

The old-style cable requires tedious surface filing and buffing before it is clean of conducting particles, and ready for the tape build-up necessary to complete the splice or termination. Even after all these preparations, the surface may still be conducting because of the semi-conducting particles remaining deeply imbedded in the insulation.

New Anaconda Durasheath eliminates the need for excessive filing and buffing. Because the semi-con tape strips clean, the bared Durasheath insulation surface is left with only slight traces of easily

"Meggers"—courtesy James G. Biddle Co., Philadelphia, Pa.

JOINTS AND TERMINATIONS ON HIGH-VOLTAGE CABLE

removed semi-conducting particles. The meter readings will show that a moment of buffing is all that's needed to complete surface preparation for tape build-ups and the most reliable splice or termination possible today.

The planned research and production program which brings you this outstanding cable development is also responsible for the equally important developments in Butyl rubber insulation compounding, and extruding, which have produced the best possible balanced design and construction in high-voltage rubber-insulated cable obtainable today—Anaconda Durasheath.

For more details, write for Anaconda Bulletin DM-5903, covering Durasheath High-Voltage Cable and DMS-5566, 5720 & 5735 dealing with the splicing & terminating of Durasheath Cable. Contact your nearest Anaconda Wire & Cable Company District Office, or write to: 25 Broadway, New York 4, N. Y.

ASK THE MAN FROM

ANACONDA®

ABOUT DURASHEATH® CABLE

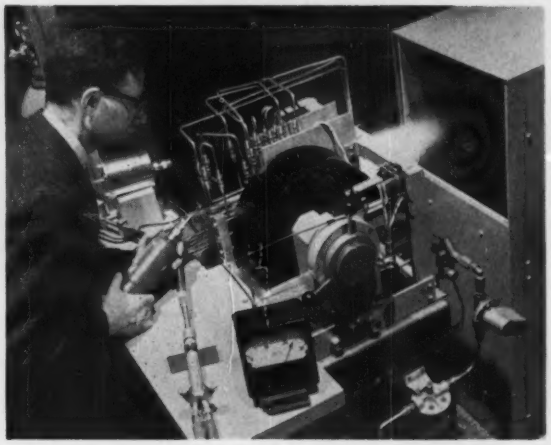
Westinghouse Demonstrates MHD Generator

Demonstration unit (right) of Westinghouse Electric's new magnetohydrodynamic power generator is operated by Dr. Werner Emmerick, research physicist, during industrial press conference and ground-breaking ceremony on February 16 at Churchill Borough.

The MHD demonstration power generator was especially constructed by scientists at Westinghouse research laboratories for experiments using combustible fuels. It blasts a stream of hot ionized gas through a magnetic field at velocities up to 1,100 mph.

A larger MHD power generator, operating at about one-half full power rating, has produced 5 kw of power and has run continuously for four minutes. It is the first MHD generator of appreciable size, says Westinghouse, steadily to produce electric power from combustion of a conventional fuel. It burns furnace oil with oxygen at temperature of about 5000F. Up to now, experimental MHD generators have obtained their white-hot operating plasma from the heat of an electric arc, simply changing one form of electrical energy into another.

The new Westinghouse laboratory at Churchill Borough will double the size of research facilities there and will push the company's total expenditure for such construction within the last ten years past the $40-million mark. Last year's $190-million over-all research and engineering expenditure will be repeated in 1960. Percentage of sales dollar devoted to research has doubled since 1950.



The week before the press conference was held, Westinghouse had a "state-of-the-art" presentation for about 200 of the nation's top utility executives. Four new methods of power generation were covered: MHD, fuel cells, thermoelectricity, and thermionic conversion.

A "major breakthrough" in materials is needed, Westinghouse scientists emphasize, in order to make these methods competitive for generation of large blocks of power now produced by steam power plants fired by conventional and nuclear fuels.

Skin Diving Is Aid to Nuclear Study

Skin diver inspects part of full-scale mock-up core of Pathfinder's reactor, immersed in 40-ft tank of water at Allis-Chalmers' Greendale lab. Facility permits testing of latches for fuel elements, development of refueling techniques, and perfection of underwater handling tools.

Means of Increasing Systems Earnings Evolve from GE Computer Study

General Electric has recently made computer studies which prove that reduced voltage regulator bandwidths increase system earnings of electric utilities.

According to E. E. Wejman, product planner for the company's voltage regulator product section at Pittsfield, Mass., these studies demonstrate that now bandwidths as narrow as ±¾ v are considered practical from any standpoint. This includes equipment life.

Electric utilities have always recognized desirability of a narrow bandwidth for step-type voltage regulators. However, in some cases it was previously felt that the increased number of regulator operations resulting from a more narrow bandwidth would mean vastly increased maintenance cost and shortened equipment life. Wejman pointed out emphatically, that by analyzing actual (as opposed to theoretical) data, GE has demonstrated that this has not been the case.

He cited, as a typical example, the case of an ML32 regulator with a nominal contact life rating of one

(*More News of Manufacturers, p* 96)

ALL THE ADVANTAGES OF A "VISE-TYPE" CONNECTOR FOR HOT LINE INSTALLATION

FIELD PROVEN "VISE-TYPE" DESIGN

. . . no loose parts to handle.
. . . protected threads assures easy removal.
. . . vibration proof interlocking of parts for long service.
. . . high conversion of applied bolt torque to clamping force.

DESIGNED FOR ALUMINUM AND ACSR

. . . extra long, parabolic shaped jaws gives better contact on conductors.
. . . low interstrand resistance assured by exerting clamping force on all strands.
. . . large mass rapidly dissipates heat holding conductor temperatures down.
. . . suitable for use on bi-metal connections when protected with liberal application of Fargolene Fourteen, a corrosion inhibitor.

PURE ALUMINUM SPACER

. . . direct, short, high conductivity path between conductors for low joint resistance.
. . . low resistance joint, long contact areas, good conductor encirclement permits heavy duty use.
. . . ears of spacer easily formed to securely hold tap in position.

EASILY INSTALLED

. . . "BC-Series" connectors are quickly installed with standard hot line tools by one man.

STIRRUPS ("BC-AHS SERIES")

. . . preformed and factory installed copper rod with heavy hot tin plating, makes use of either bronze or aluminum clamps possible.

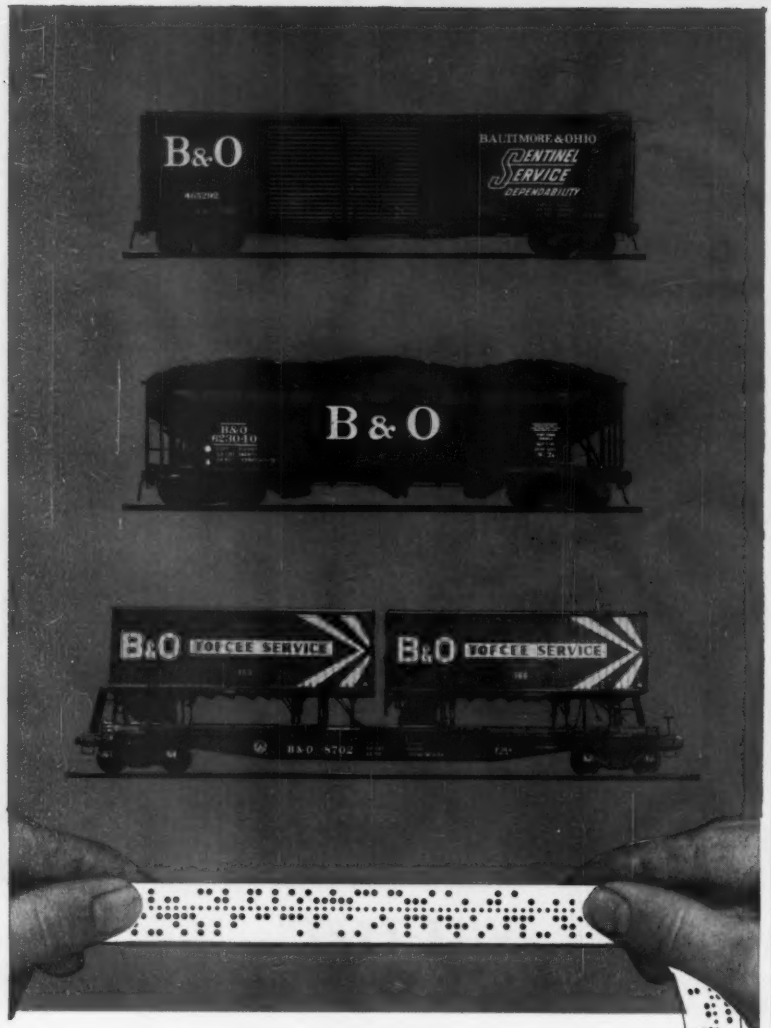
Ask your line Material Field Engineer
for complete details.

Patented

Distributed by
LINE MATERIAL INDUSTRIES
McGraw-Edison Company
Milwaukee, Wisconsin

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie
New York

FARGO



Shippers get an extra "measure of service" with B&O . . . DOT . . .

It's a new performance measure of electronic railroading! . . . DOT . . . picks up car movement information *progressively* from 43 B&O yards . . . sorts and transmits it to B&O System headquarters 24 hours a day. . . . DOT's . . . continuous, speedy flow of car information lets 58 B&O traffic offices know where carloads are at all times . . . and it covers all commodities. You'll get extra shipping satisfaction from . . . DOT . . . ! Ask our man!

B & O DATA DOT ON TRACING ®

B&O BALTIMORE & OHIO RAILROAD

The Line of SENTINEL Service • TIME SAVER Service • TOFCEE Service

GE Makes Computer Study

(*Continued from page* 94)

million operations. Over a 20-year period this regulator can perform 50,000 operations per year without replacement of switch contacts. At present many utilities have regulators such as these set with a 3 to 3½-v bandwidth to restrict regulator operations to 15,000 to 20,000 per year. This is far short of the equipment's design capabilities.

Step-type regulators, Wejman said, when applied to a system, provide improved distribution system voltage control, enable a utility to provide more usable kva on the line, and permit increased loading of existing feeders. Such advantages, he added, can significantly contribute to utility system earnings.

NEMA Elects Members Of Two New Divisions

Board members of two newly organized divisions have been announced by Joseph F. Miller, managing director of National Electrical Manufacturers Association. The Lighting Equipment Division and Industrial Equipment Division are the fourth and fifth divisions to be formed under NEMA's reorganization plan.

The Lighting Equipment Division is made up of the following product sections: Aviation Ground Lighting, Foodlighting, Industrial and Commercial Lighting Equipment, and Street Lighting.

Chairman of the division is Clarence C. Keller, executive vice president of Holophane Co. Elected vice chairman is E. B. Karns, product manager, outdoor lighting products, lighting div, Westinghouse Electric. Other members of the division's board are: J. A. McDougall, vice president in charge of sales, Revere Electric Mfg; K. C. Dorland, manager, outdoor lighting products, Union Metal Mfg; J. Stanford Smith, general manager, outdoor lighting dept, General Electric; and A. C. Kendall, general manager—fixtures, Sylvania Lighting Products, Div of Sylvania Electric Products.

The Industrial Equipment Division is made up of the following

(*Continued on page* 101)

ALLIS-CHALMERS

Extra years of capacitor life

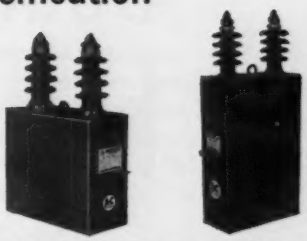
through "extra-low" drying and degasification

Why take the trouble to extract air and moisture with high vacuums? This is to guarantee that you get the greatest return from your Allis-Chalmers capacitor dollar!

Better vacuum processing — a carefully controlled combination of heat and extremely high vacuum — means better penetration of the *Chlorextol* insulating liquid into the packs. Insulating paper losses and heating are reduced, electrical strength is gained. Thorough degassing increases voltage level at which corona starts. It all adds up to a big, built-in margin of safety for severe overvoltages and high ambient temperature . . . for *extra* years of capacitor life.

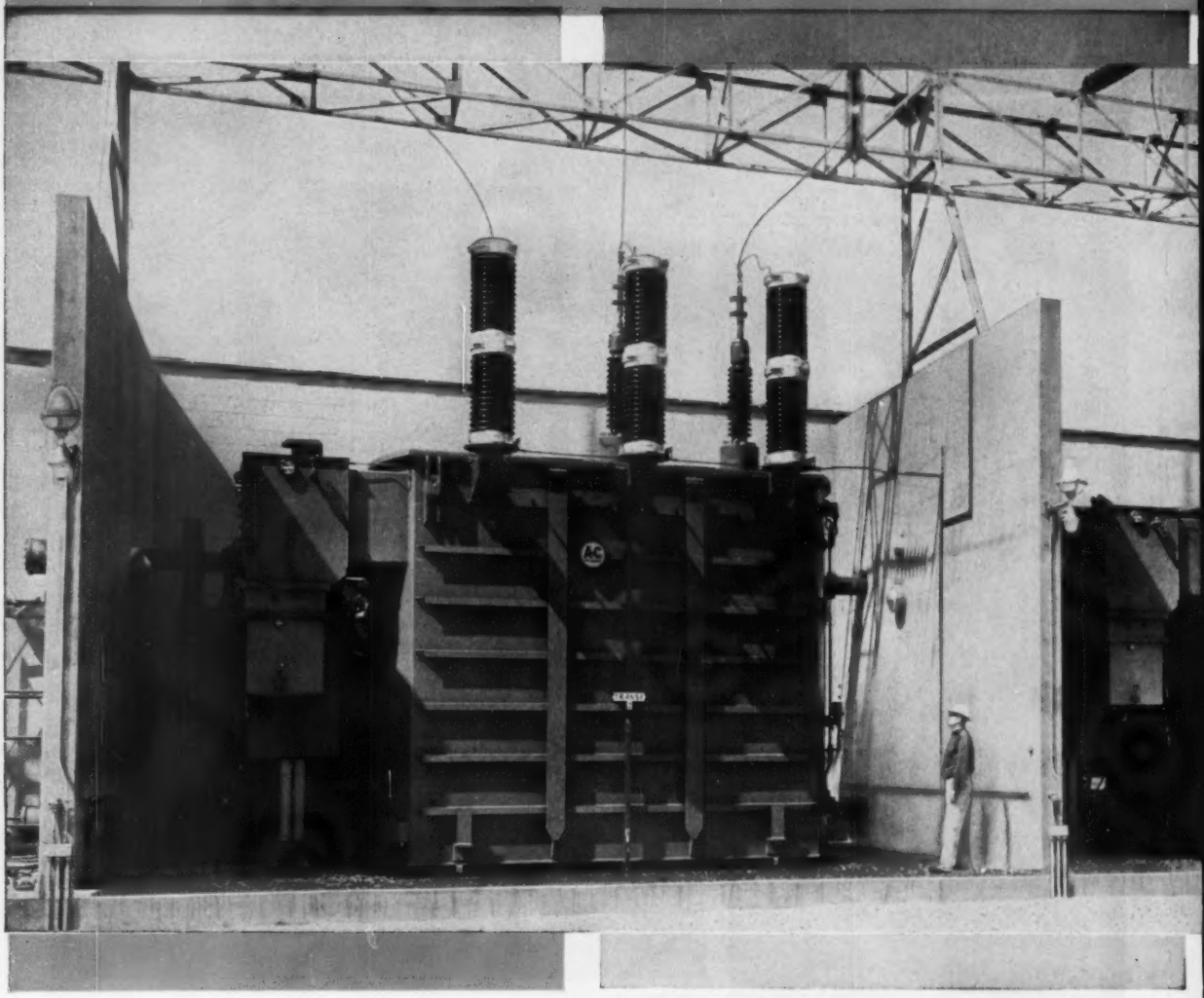
For more capacitor facts, call, wire or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-1220

Chlorextol is an Allis-Chalmers trademark.



Complete capacitor equipment is available for immediate shipment—25 and 50-kvar units—2400 through 7960 volts. Includes racks, voltage and current controls, other accessories.

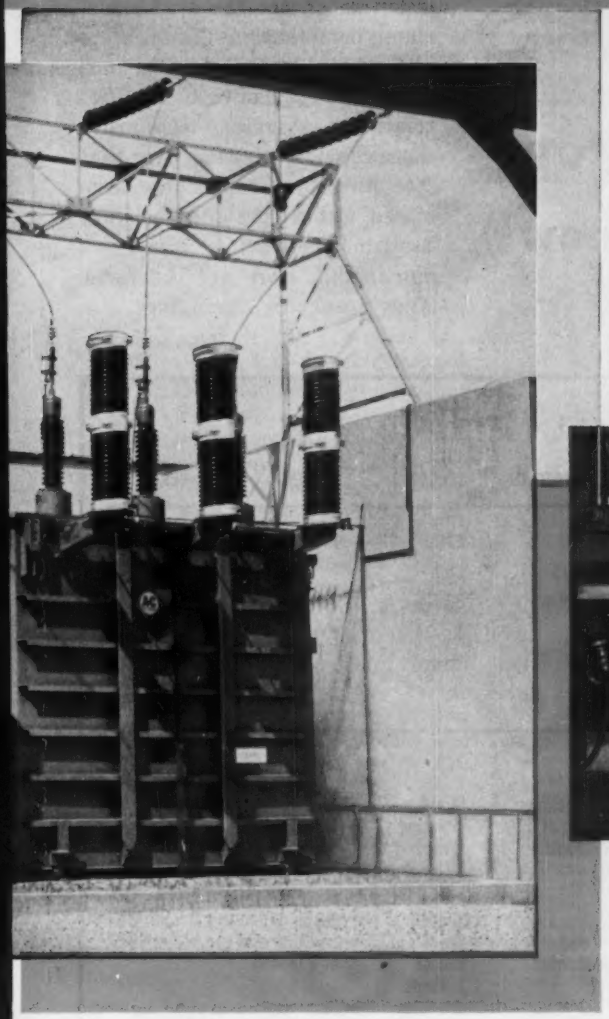
ALLIS-CHALMERS... Pacing



AT WISCONSIN ELECTRIC POWER COMPANY

Dual cooling takes the heat off emergency loads

*Patented



Manual shutoff valves serving transformer cooling equipment piping are opened when dual cooling is necessary. A transformer can be taken from service without draining the oil from the unit or its piping.

A-1155-E

Either of two 90-mva transformers is capable of carrying 2/3 of the combined capacity by using the "dual-cooled" feature

Wisconsin Electric Power Company counts on *designed-in* power transformer emergency capacity. Exclusive *dual-cooled* arrangement* uprates either one of the 90-mva transformers to 120 mva if the other is removed from the line.

The active transformer utilizes all of the other unit's oil-to-air cooling equipment to dissipate heat. In normal operation, each transformer uses its own coolers independently.

Stepping down 138,000 volts to 13,800 volts, the transformer bank employs accordion-type expansion joints between transformers. Header pipes allow for manual cutoff. The installation has been designed to permit adding a third transformer should demand require it.

Dual cooling is but one of many A-C advantages resulting from continuing transformer research. Others include corona-free design, quiet operation, reduced size and weight, high short-circuit strength. A call to your A-C man will bring further dual-cooling power transformer details.

ALLIS-CHALMERS *POWER FOR THE FUTURE*

ROECLAMPS®

With Associated Cables

ARE BEST BY TEST

(and here's how we know!)

Up till now, in the absence of industry-wide specifications, it's been a catch-as-catch-can proposition to choose the *best* cable-clamp combination. Claims were all you could hang your hat on! But now a cycle of extensive field trials and laboratory tests prove more conclusively than ever that Roebling Roeclamps with Associated Cables provide the very best, most enduring circuit you can install. Here are the facts. They speak for themselves.

15 KV ROECLAMP TESTS

TESTS ON CLAMPS ALONE	ROECLAMP	SPACER A	SPACER B	SPACER C	SPACER D	SPACER E
Downward Breaking Strength#	1600	150	890	2200	?	?
Sideway Breaking Strength#	800	300	1475	100	?	?
Lightning and Tree Shielding Angle	16°	30°+	30°+	30°+	30°+	30°+
Short Circuit Breaking Strength	10,000 3ø Amps	?	?	?	?	?
Short Circuit (Design Test) Guarantee	Yes	No	No	No	No	No
TESTS WITH CONDUCTORS IN PLACE						
35 KV between phases	No Tracking 12 Months	Tracking end of 6 Months	Tracking end of 6 Months	Slight Tracking end of 1 Month	No Tracking end of 1 Month	?
35 KV between messenger and phase conductor	No Tracking 12 Months	Tracking end of 6 Months	Tracking end of 6 Months	Slight Tracking end of 1 Month	Slight Tracking end of 1 Month	?
Radio Interference Tests						
(a) by Corona Level Test Set	16 KV 1ø	?	No Tests	No Tests	?	?
(b) by AM Radio within 2 ft of phase conductor	26 KV 1ø	?	No Tests	No Tests	?	?
Impulse Strength	*171 KV	?	No Tests	No Tests	?	?

*Test made only on 5 KV Roeclamps with Associated 5 KV Cables.

MORE FACTS ABOUT ROECLAMPS

They're available for systems up to 15kv... they minimize tree problems, save 75% over self-supporting cables, and can be installed quickly, even with "boxing" gloves on... they don't have to be removed when making phase changes, or reinforcing system... they provide better voltage regulation and higher current-carrying capacity... they practically eliminate outages from falling limbs or lightning... and they give a more compact, more attractive installation! Let your Roebling representative show you the Roeclamp... or write today for an interesting, free booklet. Roebling's Electrical Wire Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

NEMA Reorganization

(*Continued from page 96*)

NEMA sections: Industrial Control, Motor and Generator, Renewal Parts, Carbon, Manufactured Graphite, Arc Welding, Electrical Contacts, Industrial Automatic Systems, Automatic Temperature Controls, Absorption, Industrial Heating Units and Devices, Mining Belt Conveyor, and Mining and Industrial Locomotive.

The division's chairman is E. E. Helm, president, Reliance Electric. Other members of the division's board are: R. D. Thomas, Sr., chairman of the board of Arcos Corp; G. L. Simpson, division president, Pittsburgh Lectrodryer Div, McGraw-Edison; Ralph S. Penn, president, Penn Controls; Andrew Kaul, III, president, Speer Carbon; J. W. Fish, manager, general plate, products group, metals & controls div, Texas Instruments; D. L. Pierce, assistant manager, control dept, motor and control div, Westinghouse Electric; Edmonds Love, manager of general industry control sales, Square D; Winston L. Greene, sales manager, Watlow Electric Mfg; Harrison C. Stackpole, secretary-general manager, carbon div, Stackpole Carbon; W. E. Goodman, board chairman, Goodman Mfg; C. G. Skidmore, vice president—sales, The Louis Allis Co; and R. L. Kirkpatrick, manager, maintenance sales, apparatus div, Westinghouse Electric.

MANUFACTURERS BRIEFS

Federal Pacific has launched a manufacturing-marketing operation in West Germany. A plant in Baden will produce a complete line of low-voltage distribution equipment which will be marketed to continental electrical markets . . . **RT&E Corp** will open its third transformer manufacturing facility, which ultimately will employ 150 workers, on June 15 at Arlington, Tex. Present plants are at Waukesha, Wis. and Portland, Ore. . . . **Westinghouse Electric** has announced it will expand semiconductor department facilities by 30% in Youngwood, Pa.

(*More Procurement & Products p* 102)

Now—A *unitized* power pack for *maintenance free* switchgear tripping and control!

Utilities and industrial plants can greatly increase their margin of reliability and protection for switchgear and control equipment by using C & D's *AutoCal** *unitized* Power-Pack.

Here's a dependable, high-capacity power package specifically built for tripping and control that pairs a simple, compact, C & D *AutoReg*® Silicon charger with powerful, lead-calcium grid control batteries. No adjustment or manual switching is required.

The charger is a completely automatic, constant voltage, current limiting unit. It regulates DC output voltage within ±1% in floating range over an AC input variation of ±10%. The silicon rectifying element has no known aging characteristics. Consequently, there are no aging taps and the attendant adjustment of these is eliminated. *AutoCal* has no moving parts and it utilizes a standard 115 volt, 60-cycle, single phase outlet as a power source.

PlastiCal® batteries** have extra thick positive plates (0.266"). They provide a high one minute rate. Lead calcium grid batteries require 1/5 to 1/10 as much current to maintain a fully charged condition as do conventional batteries. Consequently, there is so little electrolysis of water occurring that the batteries need be watered only once a year.

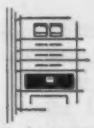
The combination of a C & D *AutoReg* charger and *PlastiCal* battery gives you self-protected charging . . . instantaneous peak power on demand . . . and long trouble free life.

Get the full details—write for Bulletin AR-102 today !

CHOICE OF MOUNTINGS

CUBICLE MOUNTING. Most popular method mounts *AutoCal* on the door of associated breaker cubicle.

WALL MOUNTING. Charger may be wall mounted near bank of indoor switchgear.



RELAY RACK MOUNTING. Charger is available with front panel for standard 19" relay rack.

WEATHER-PROOF OUTDOOR MOUNTING. Both charger and batteries fit in a weather-proof cabinet for use with outdoor switchgear.

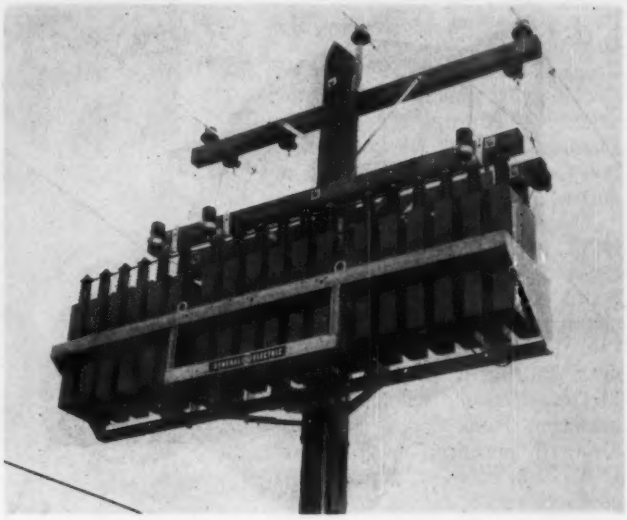
C&D C & D BATTERIES
of Conshohocken, Pa. . . . Attica, Ind.
DIV. THE ELECTRIC AUTOLITE CO.

Manufacturers of Slyver-Clad® Industrial Batteries • PlastiCell* and PlastiCal® Batteries for Communications, Control, and Auxiliary Power • Producers of AutoReg® Silicon Chargers and AutoCal* Charger-Battery Combinations

**Trademark, C & D Batteries Div. The Electric Autolite Co.*
***Designed for 25 year life*

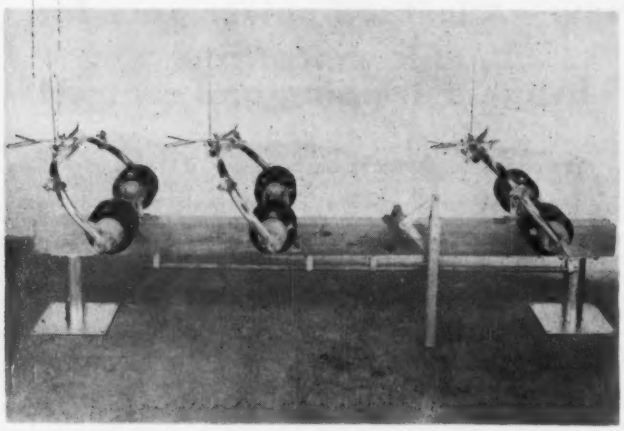
(For further information refer to Readers Service on page 107)

Capacitor Equipments . . .



. . . in 900-kvar, single-row, pole-type units are now available. The equipments, using 50-kvar units, are factory-assembled and ready for installation on the pole. They weigh about 1,690 lb and measure 107 in. in length, only 5 in. longer than the first 600-kvar equipments introduced in 1956, while weighing 60 lb less. Weight, size, and installation time of 300 and 600-kvar single-row equipments have also been reduced.

General Electric Co, Schenectady 5, N. Y.



Pole-Top Switch . . .

. . . requires little maintenance and can be used in places on the line where installation was previously considered too expensive. The switch, available in ratings of 400 and 600 amp, 7.5 through 69 kv, is designed to operate under line tensions from zero to 12,000 lb. It can be adapted to all line configurations.

Powerdyne Inc, 17150 SW Boones Ferry Rd, Oswego, Ore.

EDP System . . .

. . . provides automatic "in-line" records processing. Data are accepted in random order, and all affected records are automatically updated in an uninterrupted sequence of operations. The basic system of the fully-transistorized RPC-9000 includes: a central processing and control unit which operates in microseconds, performs the calculations, and searches the external memory tape; and an input-output tape typewriter system that reads paper tape at 60 characters per sec, and punches tape at 30 characters per sec.

Data Processing Div, Royal McBee Co, Port Chester, N. Y.

(*More New Equipment on page* 108)

RT&E Terra-Trau
Terra-Trau
4307
37½
1960 REPORT ON THE RT&E
Terra-Trau
FIRST TRANSFORMER
FOR ECONOMICAL
UNDERGROUND
DISTRIBUTION

Terra-Tran FOR RESIDENTIAL APPLICATION

ENGINEERING TALENT CONCENTRATED ON ONE IDEA
A BETTER TRANSFORMER

Terra-Tran is being used primarily in residential underground distribution. The installation shown here is part of a new development in the Pacific Northwest, served by the Portland General Electric Company. Homeowners everywhere approve Terra-Tran's compactness, unobtrusive appearance, and "kid-proof" safety features while linemen like the easy accessibility to operating parts, operation, and ease of installation. These features, plus lower costs for the complete underground system, have assured Terra-Tran's success.

RT&E CORPORATION WAUKESHA, WISCONSIN
PORTLAND, OREGON

Terra-Tran FOR COMMERCIAL-INDUSTRIAL APPLICATION

ENGINEERING TALENT CONCENTRATED ON ONE IDEA
A BETTER TRANSFORMER

Terra-Tran has met with outstanding acceptance in a large number of commercial and industrial applications. Shown above is a three-phase bank of Terra-Tran units in use at "Golfland", a recreational facility near Portland, Oregon. In this type of application, as in residential areas, Terra-Tran's basic advantages are readily apparent: compactness, appearance, accessibility, and safety. All combine to make this RT & E development for underground distribution a noteworthy milestone in transformer progress.

RT&E CORPORATION WAUKESHA, WISCONSIN PORTLAND, OREGON

Terra-Trau

FIRST TRANSFORMER DESIGNED FOR UNDERGROUND DISTRIBUTION

A. High voltage compartment door, baffled to prevent unauthorized entry and separately locked for safety to operating personnel.

B. Low voltage compartment door, baffled and locked to prevent unauthorized entry.

C. Bayonet-type interrupter switch for ease in sectionalizing. Designed for hot stick operation, it has load break capacity of 1500 KVA at normal voltage ratings and power factors down to 25%.

D. Bayonet-type high voltage weak-link fuse protects system against faults. Also used for isolating transformer. Designed for hot stick operation. Fuse elements can be replaced externally.

E. Secondary bushings accommodate multiple connections.

F. High voltage bushings have terminals designed for hot stick operation.

G. Compartment divider of laminated glass fiber.

H. Removable skirt for skidding transformer into place without disturbing high voltage and low voltage cables.

ENGINEERING TALENT CONCENTRATED ON ONE IDEA — A BETTER TRANSFORMER

RT&E CORPORATION WAUKESHA, WISCONSIN PORTLAND, OREGON

MN

ELECTRIC HEATING PROMOTION

For the last 30 years, Electromode people have vigorously promoted electric heating. The merchandising concepts necessary to successful promotion of electric heat to residential, farm and industrial markets are not strange to us. We make, sell, install and service every practical type of resistance heating equipment for these markets. When it is time to launch a vigorous electric heating promotion in your area, we invite you to discuss your problems and plans with us. We would be glad to help. We are confident that we can.

® Electromode

Dept. EW-30, Division of
Commercial Controls Corporation, Rochester 3, New York

Readers Service

For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below:

NEW EQUIPMENT

GE.....Capacitor Equipments ☐
Powerdyne .....Switch ☐
Royal McBee.....EDP System ☐
RT&E .....Transformer ☐
Hodgman.....Lineman's Suit ☐
Up-Right Scaffolds.....Tower ☐
Bodendieck .....Clamps ☐
Cross.....Metal Sheet ☐
Kuhlman .....Transformer ☐

OTHER

_____

Manufacturers Editor
Electrical World
330 W. 42nd St.
New York 36, N.Y.

* Note: Requests must be received within four weeks of publication date, accompanied by complete information specified. This service cannot be offered to readers in foreign countires or to competitive manufacturers.

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TITLE_____
DEPT._____
COMPANY_____
ADDRESS_____
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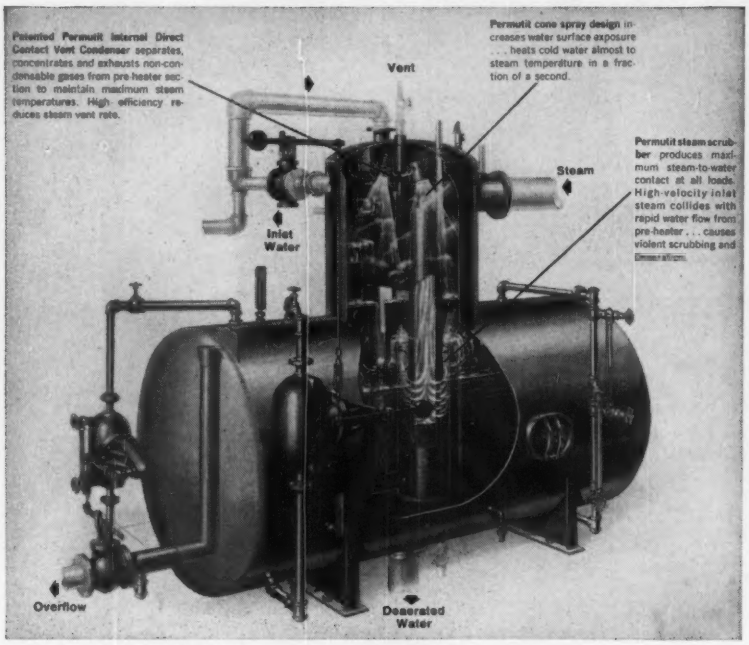
FOR:
Reference ..... ☐
Specs ..... ☐
Trial ..... ☐
Purchase ..... ☐

MARCH 28, 1960

FLUIDICS

is a Pfaudler Permutit program providing
the know-how
the equipment
and the experience
for solving problems involving fluids.


Patented Permutit Internal Direct Contact Vent Condenser separates, concentrates and exhausts non-condensable gases from pre-heater section to maintain maximum steam temperatures. High efficiency reduces steam vent rate.
Vent
Permutit cone spray design increases water surface exposure . . . heats cold water almost to steam temperature in a fraction of a second.
Steam
Permutit steam scrubber produces maximum steam-to-water contact at all loads. High-velocity inlet steam collides with rapid water flow from pre-heater . . . causes violent scrubbing and deaeration.
Inlet Water
Overflow
Deaerated Water

FLUIDICS AT WORK

New deaerators guarantee less than 0.005 ml/l oxygen at all loads

This is the new Permutit Type B Deaerator. Both horizontal and vertical designs hold oxygen to 0.005 ml/l at all loads up to a peak of 150,000 lbs/hr.

No trays to be removed or cleaned. Tubeless internal vent condenser eliminates tube cleaning, also.

30,000, 50,000, and 70,000-lbs/hr horizontal units are available from stock. They come as packaged units with all internals, including sprays, completely assembled. Pre-fitted float-cage and gauge-glass piping further simplify installation.

Capacities from 150,000 to as much as 3,000,000 lbs/hr are available in Permutit Type A Deaerators.

For more information, write to our Permutit Division, Dept. EW-30, 50 West 44th St., New York 36, N.Y.

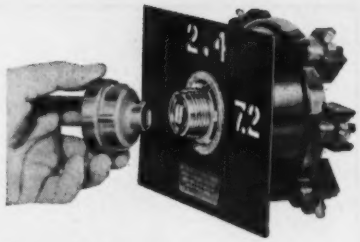
Fluidics covers such varied phases of fluid handling and control as:

corrosioneering	drying
water treatment	blending
waste treatment	metering
reactions	valving
ion exchange	piping
gas analysis	pumping
agitation	storing

Whenever you have a fluid-handling problem, look to this Pfaudler Permutit FLUIDICS program for the best solution.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes



Transformer . . .

. . . **has dual-voltage switch** which provides common operating shaft for all dual voltage arrangements, including non-multiples such as 2,400 x 7,620. The device (Extern-O-Switch) uses a new application of a specialized glass-reinforced filled Polyester thermosetting material which is non-track, arc-extinguishing, inert to oil and thermo-cycling's aging effects, and highly resistant to physical abuse and shock.
RT&E Corp, Waukesha, Wis.

Nylon Lineman's Suit . . .

. . . **using a new fabric coating,** Horcohyde, has a soft, flexible, leather-type finish that is unaffected by cold weather. Horcohyde has high abrasion resistance and is unaffected by gas, oil, grease, and sun. The suit (No. 1212) is of bright yellow for increased safety.
Hodgman Rubber Co, Framingham, Mass.

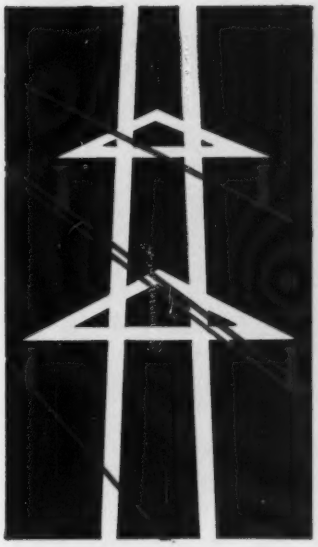
Telescoping Tower . . .

. . . **speeds street lighting maintenance.** The tower, known as Tallescope, has been mounted on electrically-powered trucks for street light maintenance throughout England. The aluminum tower is adjustable

(*Continued on page* 110)

IBM 1620 *data processing system*

...the most powerful engineering computer in its low price class



In the Electric Utilities Industry the IBM 1620 solves problems like these:

- *systems planning and simulation*
- *load flow computation*
- *short circuit studies*
- *economic fuel purchase*

The new IBM 1620 is a desk-size engineering computer that offers you more computing ability per dollar than any system in its price class.

Transistorized throughout, the IBM 1620 has a 20,000-digit magnetic core memory with variable field length and immediate accessibility. Its input-output notation, on paper tape and console typewriter, is in convenient decimal arithmetic. It can perform more than 100,000 calculations a minute and is easily adapted to your engineering problems.

Easy to learn, easy to operate, easy to communicate with, the low-cost 1620 helps free your engineering talent for more creative work. And in keeping with our concept of Balanced Data Processing, the IBM 1620 is supported by extensive services. This includes a comprehensive library of mathematical routines and specific industry programs to permit you to put the 1620 to work without unnecessary delay.

Ask your IBM representative about the unique advantages of the IBM 1620. Like all IBM equipment, it may be purchased or leased.

IBM® *balanced data processing*

*Trademark

"Superforms* help me keep lines in service"
...DISTRIBUTION ENGINEER

"To me, the word 'Superformed' means a number of plus values:

"*Service continuity* to keep our customers satisfied . . . *low maintenance costs* . . . in short, *greater dependability* and *savings*."

Everywhere, Distribution Engineers . . . *the men technically responsible for keeping customer lines in service* . . . acclaim Fanner Superforms.

A-1588A

FANNER
Superformed
with a
"PROTECTIVE TWIST"

ARMOR RODS...
Protect long-span T&D lines at supports

LINEGUARDS...
Protect short-span T&D lines at supports

PATCH RODS...
Repair damaged conductors

TAP ARMOR...
Protects conductor at tapping points

FANNGRIPS...
For dead-ending strands and conductors

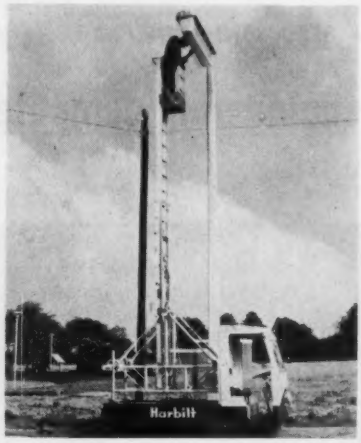
FANNSPLICES...
Join two ends of conductor wire

PLASTIC PRODUCTS...
For conductor surface protection

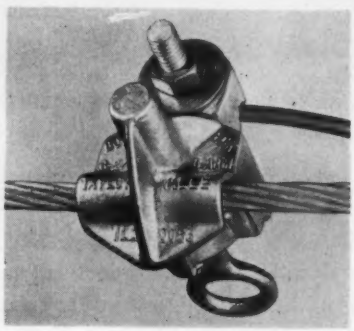
FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

Telescoping Tower . . .

(*Continued from page* 108)



to reach heights up to 33 ft and folds down to a horizontal position for highway transport. Base legs are instantly adjustable to compensate for road slopes.
Up-Right Scaffolds, 1013 Pardee, Berkeley, Calif.



Hot Line Clamps . . .

. . . **feature deep groove,** long contact surfaces desirable for ACSR and stranded aluminum conductors. Both the line screw and the tap bolt have stainless steel Belleville springs which remain unflattened and provide high-pressure compensation for high current surges.
Bodendieck Tool Co, Rt 48 N, Taylorville, Ill.

Pierced Metal Sheet . . .

. . . **for dewatering coal** has improved longevity. Trapezoidal holes, pierced in sheets of carbon steel, stainless steel, copper, brass, or aluminum, range in diameter from 0.004 to 0.099 in. Sheet thickness can be up to seven times hole diameter.
Cross Perforated Metals, National-Standard Co, Carbondale, Pa.

Enclosed Transformer . . .

. . . **for residential underground distribution** attaches to cabinet with four bolted clips. An insulated panel separates high and low-voltage compartments. Self-contained

load-breaking primary selector switch provides for sectionalizing and protection. The cabinet accommodates 15 to 100-kva units.
Kuhlman Electric Co, Birmingham, Mich.

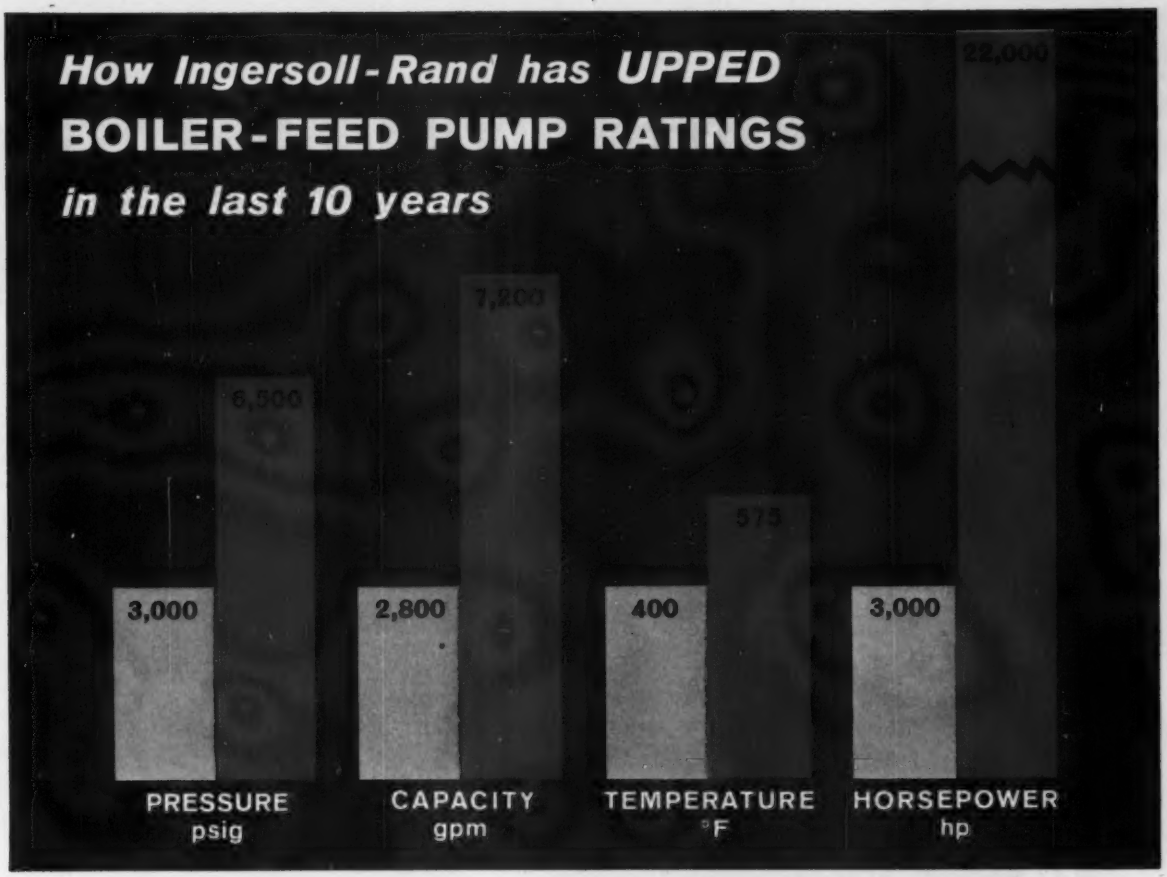
More New Products

Automatic **fire detectors** feature sight glass for ease of inspection. They are available with temperature ratings of 136F or 174F.—Falcon Alarm Co, Summit, N. J.

Multi-layer, sectional-type **thermal insulation** of calcium silicate-asbestos fiber bonded felts is designed for temperatures of 200 to 1,200F. It is called Zebra. — Keasbey & Mattison Co, Ambler, Pa.

Low-cost **crane control** (Type PT) has self-contained undervoltage and overload protection. It provides full magnetic control on any dc application up to 55 hp, 230 v.—EC&M Div, Square D Co, 4500 Lee Rd, Cleveland 28, Ohio.

How Ingersoll-Rand has UPPED BOILER-FEED PUMP RATINGS in the last 10 years



...to help power companies produce more kilowatts with better efficiency

In this chart of pump progress, none of the figures are theoretical. They are actual performance ratings of I-R boiler-feed pumps installed or now on order.*

The progress to higher and higher pump ratings has been made possible by improved design engineering, better metallurgy, improved manufacturing methods and advanced hydraulic research. To the user, it means simpler installations with fewer pumps to do a given job—higher operating efficiencies—better heat rates—improved steam plant performance and economy.

Combine this record of pump *progress* with Ingersoll-Rand's traditional *dependability*, and you'll see why Ingersoll-Rand is clearly recognized as the world's leading manufacturer of boiler-feed pumps. In short, this is why it always pays to discuss your pump requirements with Ingersoll-Rand.

11,000 horsepower boiler-feed pump undergoing performance tests in Ingersoll-Rand's new testing department. Pump is capable of handling 3600 gallons of feed water per minute at 4550 psig discharge.

**The figures shown do not represent limits of I-R boiler-feed pumps. If your particular application falls outside of the ranges shown, we would welcome the opportunity to discuss it with you.*

A CENTURY 1860 – 1960 OF PUMP PROGRESS

Ingersoll-Rand

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COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

US RUBBER TAPES

YOU RESTORE THE DIELECTRIC WHEN YOU TAPE

Here are famous brands preferred by electricians wherever wire or cable must be repaired in utilities, factories or mining service. After the splice has been made, restore the dielectric qualities of your original insulation with a rubber tape and then protect its physical and abrasion resistance by an additional covering of friction tape.

U. S. SECURITY® FRICTION TAPE

Although competitively priced, this outstanding grade of electrical and general-purpose tape has all the characteristics of higher priced tape. It contains no pinholes—does not ravel when unwound from the roll—tears straight.

U. S. SECURITY RUBBER TAPE

The ideal commercial quality of unvulcanized rubber tape for all general electrical work.

U. S. Security rubber splicing compound possesses all the necessary physical properties: tensile elongation, tackiness and dielectric strength required for good, durable splices.

It is easy to handle and will fuse into a solid mass without the application of heat or undue pressure.

AND PHYSICAL QUALITIES WITH "U.S."

U. S. HOLDTITE® FRICTION TAPE

Contains no free sulphur or other ingredients injurious to metals or fabrics. Exceeds all the physical requirements of the A.S.T.M. specification. Handles cleanly without raveling or waste—has no pinholes—has high dielectric strength for high voltage jobs.

It has unusually high tensile strength and strong adhesion and makes splices that are durable and lasting.

U. S. HOLDTITE SPLICING COMPOUND

A high-grade rubber splicing compound exceeding A.S.T.M. requirements.

U.S. Holdtite rubber splicing compound is economical when considered on a cost-per-foot basis. Its high dielectric strength, combined with its fine tackiness and fusing qualities, insures perfect splices.

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

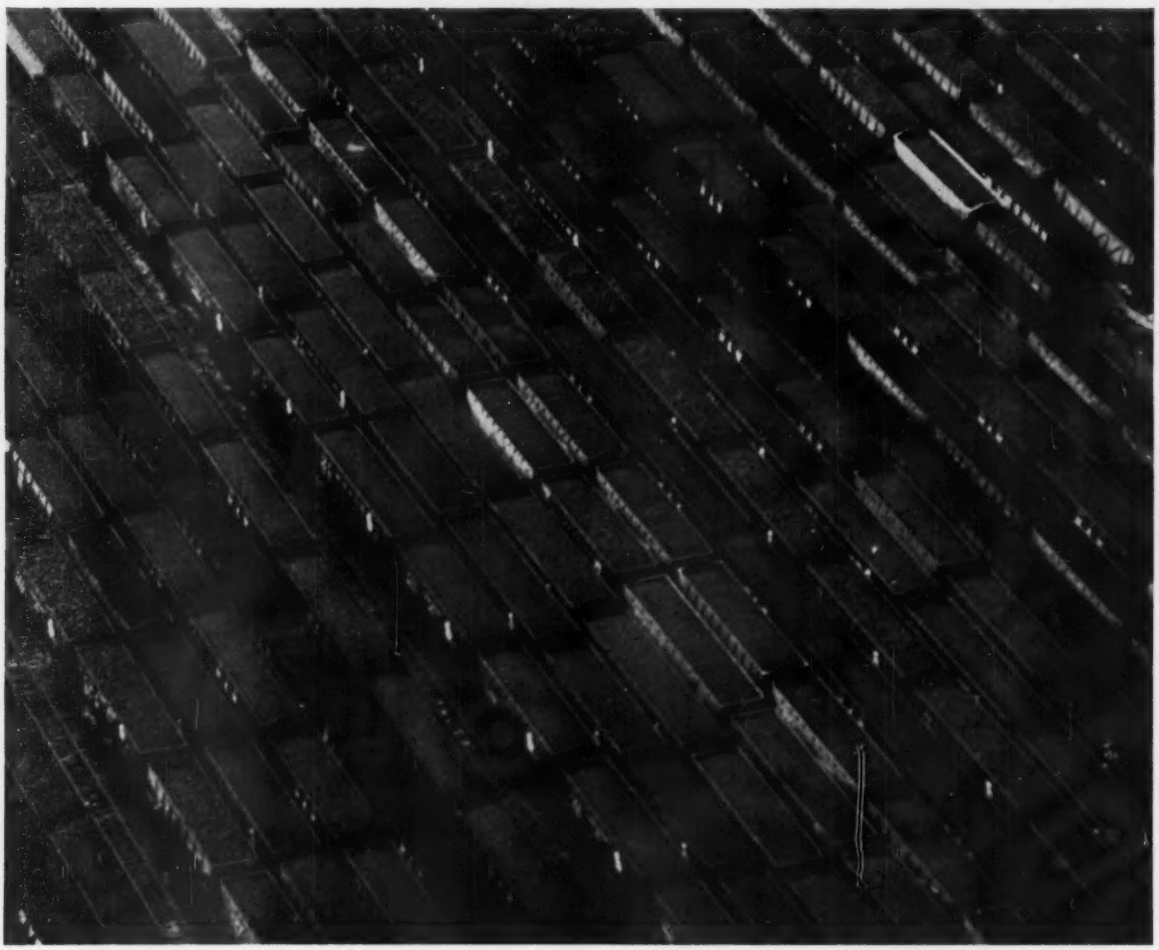
Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

how long?...10 years?...20?...50?

(A utility needs to know!)

There has never been much room for short-term thinking in the utility business. But probably never before have utility executives and engineers been taking *the long look* in so many operating areas.

Take coal, for instance. They've been asking themselves and their coal suppliers some pointed questions: "Can we count on these suppliers to deliver the kind and quantity of coal we're going to need in the years ahead? Have they adequate reserves? Is this coal costing us over and above its invoice price in excessive coal handling, ash handling, equipment outages, freight charges on inerts? Or is it coal that eliminates these frequently overlooked incremental costs, delivers highest operating efficiency and steam at the lowest cost?" The answers you'll get to such questions from Island Creek are the kind that let you plan ahead with confidence. We at Island Creek would welcome a chance to sit down with you for a thoroughgoing discussion. Write, wire or phone.



You can depend on Island Creek . . . a career company dedicated to coal

ISLAND CREEK
Precisioneered Coal

Island Creek Coal Sales Company, Chafin Building, Huntington 18, West Virginia • Chicago • Cincinnati • Cleveland • Detroit • Greensboro • New York • Pittsburgh

The Ideal Capital Structure?

Report on
Financing

What's the ideal capital structure? Scores of theories have been advanced. They range from complex mathematical models to inspired guesswork. And all have failed because **(1)** they've been too general to account for the significant differences between companies, or **(2)** they've been so specific they aren't theories at all—they apply only to a single case. It still remains one of the great unsolved problems in business finance.

What is the test of the ideal capital structure? Some would say, perhaps inexactly, that the ideal structure will produce the lowest weighted-average cost of capital. But a better guide is simply this: the ideal capital structure will always push the price of the company's common stock to the highest possible level. What really concerns us, then, is not the cost of capital per se, but the effect of raising capital on the value of the common shares—the ownership of the company.

The market price of common is a convenient guide. It combines, in a single figure, all symptoms of a company's financial ills, or health. The market itself appraises the company's financial history, cost of money, and prospects for the future. The outcome—price earnings ratio—is the most important element in a decision to issue debt, preferred or common stock.

Unfortunately, there is no ready-made blueprint a financial manager can follow in building an ideal structure. Since risks vary from company to company (although less for the utilities than other businesses) what is best for one may not be best for another. And even the utilities, whose relatively stable earnings allow more leeway in financing with little difference in cost, vary considerably amongst themselves. In a study of 120 well-known electric utilities (EW Jan. 11, p 74) gross incomes were shown to have fluctuated over 23%, on the average, since 1930, with great variations between companies (a range of less than 8% to more than 40%). Utilities' risks and financial problems are not as much alike as some would have us believe.

The ideal ratio of debt to equity is largely determined by investment risk. Assessing these risks, the utilities have presently built their financial structures along such lines as: **(1)** Mortgage bonds (about 52% of total capitalization), **(2)** Preferred stock (11%), and **(3)** Common stock (37%), with many companies adding some debentures as well. Some combination of these security forms will build the ideal capital structure, but arriving at it, assuming the goal can be defined, is a long term task. Capital structures are largely frozen by actions of the past, and take years to alter substantially; it's a bit-by-bit process. Whatever the alterations, the savings will depend on both the rate of expansion and market conditions.

What sort of savings could a utility expect by altering its capital structure? Here's an example: a fairly small, but typical, electric utility. Assume it expands 8% per year, and has a 40% common equity ratio—somewhat higher than the industry average. To reduce the proportion of its expensive, common stock financing, it plans to lower common equity ratio to 38% (near the industry average) over a five year period. To effect this conservative drop, it simply floats some debentures instead of selling new shares of common. The illustration on the facing page shows the method.

Here are the savings: $38,000 the first year, and $114,000 per year during the next four years, on the average. The common money it avoided raising would have cost about 6.5% (after sales expenses) at today's market prices. The cost of the debentures it sold instead was only slightly less—5.62% on today's market. But this cost is reduced by 52% (since interest is a before-tax expense) so that the effective cost of financing with debentures is just 2.7%. The difference in these equity and debt costs, 3.8%, represents the $38,000 saving on $1 million of financing the first year. In later years the saving is greater, an average of $114,000, since the amount of new financing is compounding.

This saving, however, is not as substantial as it would have been almost anytime in the past. If, instead, common money had cost about 10% (not unusual a short time back) the savings would have been approximately doubled. Furthermore, the dollar savings cloud part of the picture. The total saving over five years would increase common stock earnings just 1%.

Note that a full 60% of the "balance to be raised" in the figure at the right is raised in new bonds. That is the ratio permitted by most corporate indentures. This, of course, exceeds the industry's average debt ratio for outstanding bonds, but the gradual debt "retirement" by the sinking fund tends to keep the company's overall debt ratio permanently near the industry average (about 50%).

The rate of expansion also has a strong effect on savings in new financing. If, instead of expanding at an 8% rate, the company had been expanding at a more vigorous 10% per year, the savings would have been about 1.6 times greater than in the example. The increase in per share earnings in this case would have been about 2.5%, not 1%. And if common money had cost still more, say 10%, the savings with a 10% per year expansion rate would have been about 3.2 times greater. Earnings on common would have increased about 5% in that event, as a direct result of the savings.

But suppose the market devalued the stock after the utility took on a heavier burden of debt? It only takes a small drop in price earnings ratio to more than offset the savings from a more "liberal" financial structure. Earnings per share would have increased only 1%, 2.5%, and 5%, over the five year period, depending on the rate of expansion and the cost of common shown above. Since these increases are slight, it is clear that only a very small drop in p/e ratio would destroy the whole value of the savings by lowering the selling price of the stock on the market. The greater the percent rise in earnings per share

Which Way to Finance this Electric Utility?

The company . . .						
Gross assets				$	250	000 000
Net assets					200	000 000
Depreciation (3% of gross assets/yr.)					7	500 000
Common equity ratio (40% of capitalization)					80	000 000
Earnings on common (12% of equity)	$	9	600 000		9	600 000
Common dividends		7	000 000		7	000 000
Retained earnings		2	600 000		2	600 000
Expansion (8% of net assets/yr.)					16	000 000
Needs $16 million for expansion each year . . .						
$7 million comes from internal cash . . .						
Depreciation				$	7	500 000
Tax savings from accelerated depreciation						500 000
Less: sinking fund for bonds (1%/yr.)					(1	000 000)
Balance to be raised	$	9	000 000			
And $5.4 million from new bond sales:						
(60% of $9 million in new capital)					5	400 000
Which leaves $3.6 million to be raised by:						
Method A — hold equity ratio at 40%						
From retained earnings		2	600 000			
From sale of new common		1	000 000			
Method B — lower equity ratio to 38% in 5 yrs.						
From retained earnings					2	600 000
From sale of debentures					1	000 000
				$	16	000 000

from the savings, the lesser the decline in p/e ratio necessary to effectively cancel out the savings. Thus, if earnings per share increased greatly, say 100%, a drop of only 50% in p/e ratio would cancel out the value of the savings. Actually, the percent increase in earnings is generally so low (say, 2%) that, as a practical matter, it is safe to assume an equal percent decrease in p/e ratio (say, —2%) will cancel out the savings.

Today, there is a historically narrow spread between the cost of equity and debt financing, so that 1960 isn't a year when big savings can be made with an altered capital structure. Yet, savings can only arise during financial expansion, now or in the future. Thus, every year lost by deferring a change in financial structure is a year lost permanently in potential savings, no matter how slight they are. For most companies, the savings should be enough, even now, to be well-worthwhile—provided the p/e ratio isn't damaged in the process.

What is the likelihood that p/e ratio will be seriously damaged? Electrical World studies (EW, Nov. 9, 1959, p 105) have shown no measurable decline in p/e ratio as common equity ratios decline. This was brought out in a study of 115 electric utilities broken into groups of **(1)** those with less than 35% equity ratio, **(2)** those with from 35% to 45%, and **(3)** those above 45%. There was no significant decline in p/e ratio as the companies' equity ratios decreased. However, what is true for all is seldom true for one. The figures are averages, and as such they swallow up many significant differences between companies.

Still, with only a moderate change in equity ratio (such as a drop from 40% to 38%) the change in p/e ratio shouldn't be great. But that is no guarantee. Unfortunately, nobody has yet shown he can predict, with mathematical accuracy, the impact of a capitalization change on p/e ratio. The effect is a matter of opinion, expert or not.

Price earnings ratio might also rise if a converse action were taken. That is, if common equity ratio was pushed upwards (by selling more common) to build a larger equity base. For some companies, this would call forth a higher p/e ratio by reducing the stockholders' apparent fear of debt. If the increase in p/e ratio was sufficient, it could more than offset the loss in per share earnings created by the higher overall costs of capital, and thus lead to a higher market value for the common.

Consider, for example, a company that increased its equity ratio modestly; say an increase from 36% to 38% over five years. This situation, of course, is the converse of the first. The costs and savings would be much the same in either case—but not quite. Since fewer bonds would be floated in financing, interest payments would be lower, which would tend to increase the drop in per share earnings, at least to a degree, because of the tax effect.

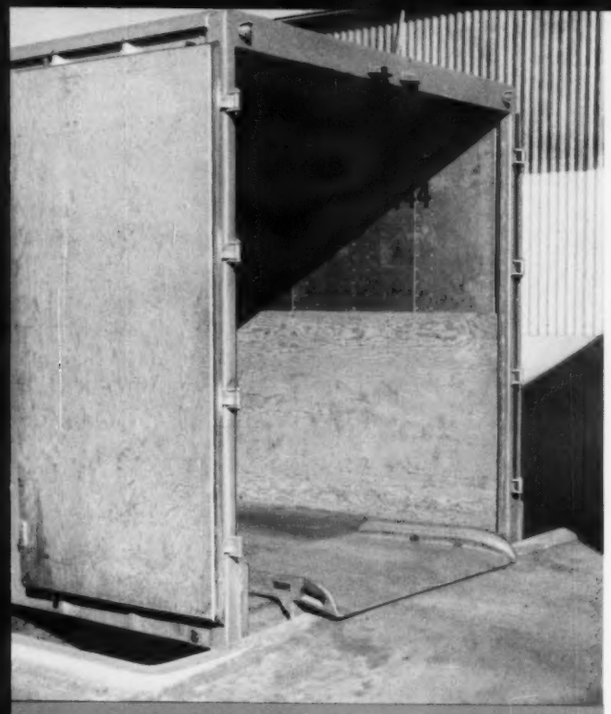
Price earnings ratios are seldom static. They change periodically with **(1)** changing conditions in money markets, **(2)** changing conditions in the electric utility business, and **(3)** changing conditions within the utility itself. Price earnings ratios are likely to continue changing, whether the capital structure is altered or not. But it is extremely difficult to determine whether the movements arise from an altered capital structure, or from economic conditions beyond the utility's control.

Assume, for example, a common stock with a price earnings ratio of 16. Suppose an adjustment in capital structure reduces it to 15.8. Then imagine the ratio snaps back to 16 again; did the snap-back in p/e ratio cancel out the original loss? Certainly not; without the adjustment in capital structure it is possible p/e ratio would now be at 16.2, not 16. Thus, p/e ratios will continue to swing, but at a new level established at the time the capital structure was changed, depending on whether or not the change increased or decreased common stock equity ratio.

The quest for the ideal capital structure seems to lead to the following:

- **Capital structures can only be altered and improved upon in the future,** when new funds are sought for expansion.
- **The effect of adding a little more equity, or debt,** to a company's financial structure is likely to call forth only a very minor shift in per share earnings. Thus, the savings, or loss, from adding debt or equity would be offset, in terms of market value, by a very small change in p/e ratio.
- **The savings and losses from these financial manipulations** are easy to calculate. But their effect on p/e ratios can't be computed. That is solely a matter for well-educated opinion.

If a utility can determine the price earnings ratio that will develop from a change in its financial structure, it has taken the biggest step toward attaining the ideal capital structure. The job is immense, and the best possible outside advice should be sought. We can offer no final solution; nobody ever has. But financial research is underway. For example, Jacoby and Weston of the University of California, back in 1952, outlined 56 variables that influence a decision to issue debt or equity. There may be a relationship between these—and probably more—variables. With electronic data processing, someday we will know. The savings aren't enormous, but they are certainly worth taking.

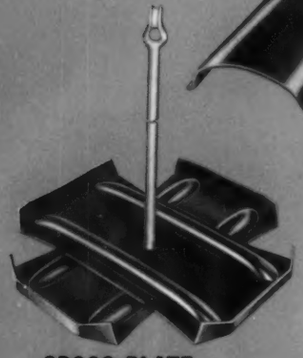


MECHANIZE with CHANCE palletized anchors

packaged and palletized at No Extra Cost . . .

8-WAY ANCHOR

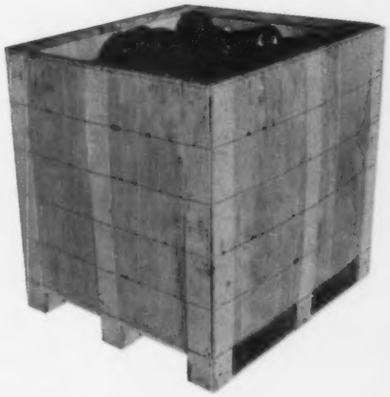
NEVER-CREEP ANCHOR



CROSS-PLATE ANCHOR

KEEP PACE ELECTRICALLY

simplify stocking and handling



● IN COLOR-CODED CARTONS

The color on the carton tells you what size anchor is in it . . . makes it easy to select the anchors you need at a glance, both in the warehouse and the field. There's no haphazard searching for a particular size; cartons store easily, anchors stay put until needed.

● ON EXPENDABLE PALLETS FOR INDOOR STORAGE

The color-coded cartons are held to the pallet—and to each other—by a special adhesive (there are no steel straps to cut), and can be removed from the pallet one-at-a-time. They break away from the stack easily; removing one doesn't disturb or loosen the others. Pallets can be stacked to reduce storage space needed. Minimize handling, too.

● IN PALLETIZED WIREBOUND CRATES FOR OUTDOOR STORAGE

Here's the best way to order your Chance Anchors in bulk. Anchors of the same size stay together in storage in neat stacks. Compact crates take up less storage space, cut handling costs, improve your stock department's "good housekeeping" practices.

● Cross-Plate Anchors are also available in bulk, strapped to expendable pallets without the crating.

Check with your Chance Representative . . . get the whole story of mechanized anchor handling.

your anchor handling

You probably have the mechanizing equipment... lift trucks and pallet trucks. So make the simple switch to faster, easier anchor handling. Next time you order Chance 8-Way, Never-Creep, or Cross-Plate Anchors, specify that they be shipped to you on pallets.

When you receive palletized anchors, unloading and handling time is cut way down. There's no time-consuming, laborious carton-by-carton loading and unloading. One man with a lift or pallet truck moves anchors from trailer or box car to storage in one continuous operation.

And pallets, of course, can be stacked... to take less floor space, releasing it for other uses. Anchor cartons can be removed as needed or whole pallet loads for big construction jobs can be moved in one simple operation.

Flip this flap for more details on how to get CHANCE packaged, palletized anchors from us to you, to the job this easy, economical way.

MECHANIZE SCREW ANCHOR INSTALLATION

Here is a way to get more out of your investment in hole-boring equipment... save anchor installation time and get better anchoring. Use it to install Chance Screw Anchors.

Your present power boring equipment, regardless of type, can be easily adapted to power anchor installations. Add to this equipment the special wrench shown at right and in use below and your crew is all set to install anchors in 5 to 8 *man* minutes. That's the time required for complete installation... *from the time the equipment is moved into position until the anchor is ready for the guy.* The wrench transmits torque from the power equipment directly to the specially designed hub on the anchor helix. Wrenches are made to fit all popular makes of earth borers. And, since the anchor rod is not subjected to torque, it only has to be heavy enough to support the guy load. That's a cost-saving factor, too.

Chance Power-Installed Screw Anchors, ranging from 78 to 176 square inches in area, go down fast into all types of soil (except extremely rocky soil). Hundreds of installation and pull tests prove these anchors hold more with less creep than any anchors of comparable size.

For the ultimate in mechanized anchor installations, use this method and get:

- Lower installation costs per anchor
- Better utilization of expensive equipment
- Greater holding power with less creep
- Consistent results
- Elimination of human variables and error
- Less physical effort, better employee relations

Contact your Chance Representative. Now. He'd like to tell you more about mechanized anchor installations, show you test results, and help you apply this new technique to save time, cut costs, and improve your anchoring.

ABC INDUSTRIES

A. B. CHANCE COMPANY
Centralia, Missouri

(A. B. Chance Company of Canada, Ltd., Toronto)

CA60-2

Next Decade Will Be Good for Appliance Sales

More than 178,000,000 kitchen-laundry appliances to be sold by 1970; single service charge plan introduced by Hotpoint

Utilities that are looking for appliances on which to concentrate promotion in the next decade would do well to consider water heaters, dishwashers, and food waste disposers.

Appliances which will go on the biggest sales booms in the next 10 years are refrigerators, automatic clothes washers, and air conditioners. More than 178 million kitchen-laundry appliances will be sold by 1970; electric baseboard heating will play a prominent role.

Fifty-million consumers will spend $10 million every day to buy these appliances. Industry sales will climb 42%.

The annual industry sales rate will reach 20,560,000 units, a 63% increase, by 1969.

The number of wired homes will reach 60,100,000 in 1969, compared with 50,600,000 today.

Utilities will be able to recommend to their customers who buy these appliances a new "single service" charge and pricing plan which eliminates all hourly charges and reduces charges for house calls up to 50%.

These are things gleamed from two special reports published by Hotpoint Division, General Electric Co.

Appliance Survey Reveals Future Sales

Other key facts on future sales of these appliances are:

Free standing ranges: Most of the 1960 sales of electric ranges will be replacement sales, 96% of the 950,000 to be sold. There will be 13,266,000 cabinet ranges in use at the end of 1969.

Built-in ovens—surface units: Industry sales will go over the million mark in 1964 and over 11.5 million will be in use at the end of the decade.

Refrigerators: In 1960, 3.8 million refrigerators will be sold, and at the end of the decade sales will increase to over 5 million a year.

Freezers: Appliance manufacturers will ship 1.2 million units in 1960, equaling last year's record. Of these, 23.5% will be replacements; 76.5% will be new.

Air conditioners: By 1969, 43% of the air conditioners sold will be replacements; whereas only 10% today are. Today there are 7½ million homes with one or more air conditioners. During the 60's this will double.

Water heaters: The replacement business will increase to over 99% in 1969. It's 92% today. The number in use today is 9.5 million, or 18.5% saturation. A slight increase to 9.75 million is forecast. Saturation, however, will go down by 1969 to 16.2%, due to the increase in wired homes. Saturation for all other appliances, except electric cabinet ranges, will go up.

Dishwashers: By 1969, dishwashers sales will be 1,320,000 of which half will be replacements.

Food waste disposers: 12,846,000 disposers are expected to be in use by the end of 1969.

Automatic washers: By 1969, the appliance industry will be selling over four million washers a year. Of these, 82% will be replacements.

Electric dryers: In ten years, 12.5 million will be in use. In 1969, sales will be 1,475,000.

Expected Unit Sales in Next 10 Years

Electric ranges and built-in ovens	20,785,000
Refrigerators	44,925,000
Food freezers	12,765,000
Air conditioners	21,810,000
Water heaters	7,500,000
Dishwashers	9,125,000
Food waste disposers	10,730,000
Automatic clothes washer	38,145,000
Automatic clothes dryer	13,025,000

Hotpoint's Single Service Charge Plan

The single service charge and pricing system has these features:

1. Eliminates all hourly labor charges. Customers will not be penalized by a new technician taking longer than a more experienced man. Servicemen can take as long as necessary, at no extra cost to the customer

2. A flat rate for making a house call

3. Eliminates charges for calls back, in case no one is home, service call is cancelled, or special parts have to be ordered

4. Serviceman can figure out the total cost of the work before it is done. Core of this is a job pricing manual which lists charges for these services categories: replace, repair or adjust

5. Maintenance of customer satisfaction through surveys within a few days after service is performed.

The system was tested by Hotpoint for four months, and has now been adopted in 47 cities.

Saturation in 1969

Electric cabinet ranges	22.1%
Electric custom ranges (including surface units)	19.4
Refrigerators	100.0
Freezers	31.5
Room air conditioners	26.1
Dishwashers	14.9
Disposers	21.4
Electric water heaters	16.2
Automatic washers	55.5
Electric dryers	20.9

Again in '60

FORD PICKUPS beat all leading

New and certified proof that Ford

Ford Six delivers 13.1% better gas mileage in second running of Economy Showdown U.S.A., conducted by America's leading independent automotive research organization. Standard 1960 ½-ton pickups of the five leading makes were purchased from dealers just as you would and tested for over-all gas economy. The trucks were run both empty and loaded, over flat terrain and hills, at low and high speeds, and under city traffic and retail delivery conditions.

Certified results show the Ford Six won *every* test—with marked superiority in the tests covering city traffic and retail delivery conditions. The combined Ford advantage for all the tests was 13.1% more mpg over the average of all the other makes tested. In fact, the Ford Six beat one competitive pickup by a whopping 27%.

The 1960 Fords not only deliver the best gas mileage of the leading makes – but they do it without sacrificing any of the performance characteristics for which Ford is famous. Ford's highly efficient carburetion system meters fuel more precisely at both low and high speeds, providing the right balance between power and fuel consumption for the best economy of operation in all kinds of driving.

And that's not all . . .

makes in Gasoline Economy!

Trucks give you greatest gas savings

Ford gives twice the tire life with proven truck-type front suspension. Ford's solid front axle and leaf spring suspension system maintain constant front wheel alignment better than the "soft-type" independent suspension used on some 1960 trucks. Certified results of tests conducted to determine the tire wear of equally loaded trucks with the two types of suspension showed that, under average operating conditions, the independent suspension wears out front tires twice as fast. And the difference in tire wear can save you as much as $300 over the life of a pickup.

Ford is priced below all other leading makes!* New 1960 Ford ½-tonners are priced from $33 to $181 below those of leading competitive makes. Two Tone paint, power steering, wrap-around rear window plus many other desirable options also cost you less in a Ford. And, if you need a larger pickup a check of the suggested list prices will show Ford's prices for ¾- and 1-tonners to be the lowest of them all.

Ford offers Certified Proof! Yes, this year, if you buy a Ford instead of a competitive truck, you can be sure to save—Ford's economy is certified! Check the certified records yourself in your Ford Dealer's "Certified Economy Reports" . . . see and drive the new Ford Trucks . . . check the price tags . . . *and you'll save for sure!*

**Based on latest available manufacturers' suggested retail delivered prices, including Federal excise tax, excluding dealer preparation and conditioning and destination charges*

FORD TRUCKS COST LESS

LESS TO BUY . . . LESS TO RUN . . . BUILT TO LAST LONGER, TOO!

Oklahoma G&E Names Mailer Vice President

Oklahoma Gas & Electric Co has named James I. Mailer, (right) vice president and Arkansas Division manager, and Wayne A. Parker, general superintendent of construction. Mailer was replaced as Arkansas division auditor by D. G. Lane. Mailer fills the post created by the retirement of Morgan Wright.

Mailer was formerly division auditor for the Arkansas properties of the company. Parker had been assistant superintendent of construction.

In the generation department, John D. Graham, formerly assistant chief engineer at Mustang station, OG&E's largest power plant, becomes chief engineer in charge of the station, replacing Leonard D. Husky, who died recently. George Gibbons has become assistant chief engineer, and replacing him as assistant chief engineer at Riverbank station near Muskogee is George Binkley. For the past eight years, Binkley has been results engineer at Horseshoe Lake station at Harrah.

Joslin Made VP-Operations at CP&L

Ennis S. Joslin has been promoted to the newly created position of vice president in charge of operations for Central Power & Light Co. He had been a vice president in charge of the company's advertising, commercial and rural service activities.

A CP&L employee for more than 30 years, Joslin joined the company as cashier at Alice, Tex., and transferred a few months later to Kingsville. In 1928 he moved to Corpus Christi where he was promoted to chief clerk in 1930, became manager in 1931, and Corpus Christi district manager in 1939.

He has also been a director of the company since 1953.

Sylvania Names Three to Be New Vice Presidents

Sylvania Electric Products, Inc, has named three new vice presidents. They are: Alfred C. Viebranz, vice president-marketing services; Frederick H. Heintz, vice president-marketing, large lamp products for the Sylvania Lighting Products Division; and Robert L. Kleinfeld, vice president-marketing, photolamp and special products for the Lighting Products Division.

VIEBRANZ HEINTZ KLEINFELD

Viebranz will have responsibility for corporate marketing services including advertising, sales promotion, market research, and sales management development.

Heintz will head marketing programs for incandescent, fluorescent, and mercury vapor lamps.

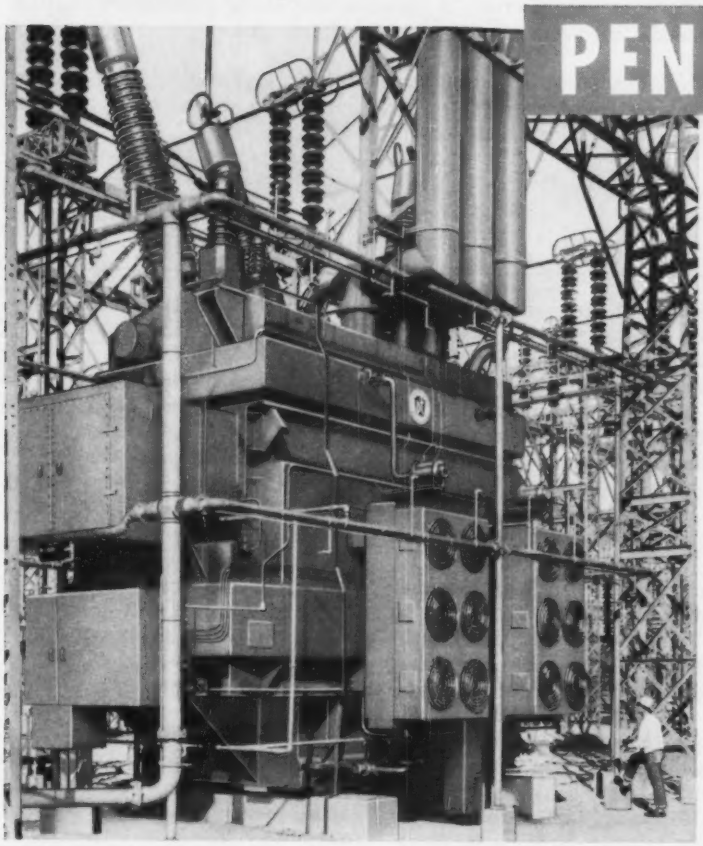
Kleinfeld will have marketing responsibility for "Panelescent" lighting, circuit breakers, transformers, airport lighting, and microminiature lamps.

Viebranz joined Sylvania in 1946, and is now returning to the company after being with Young & Rubicam, Inc, for the past five years. Heintz joined Sylvania in 1942 and was most recently regional sales manager in Chicago. Kleinfeld has been general marketing manager-photolamps since last October.

(*More News About People, p* 128)

FOR 330 Kv POWER . . .

Atomic Energy Plant Relies on Two 100,000 Kva Transformers by PENNSYLVANIA



LOAD TAP CHANGING PENNSYLVANIA POWER TRANSFORMER

. . . one of two 100,000-kva Pennsylvania transformers located at the Portsmouth, Ohio, plant of the Atomic Energy Commission. The transformers step down a transmission voltage of 330,000 volts to 14,400 volts for plant distribution.

Two 100,000-kva Pennsylvania Power Transformers play a key role in the distribution of power throughout the Atomic Energy Commission's Portsmouth plant. With a high voltage rating of 330,000 volts, these "step-down" units are among the highest voltage transformers ever manufactured for use in this country. Their integrated load tap changing equipment boasts the "quiet ruggedness" that is so desirable in most present-day installations.

Other Pennsylvania features include corona-free high voltage coils that are designed for uniform impulse voltage distribution . . . and of course the well-known Pennsylvania "Contour Design" construction, which results in space-saving, weight-saving compactness.

McGRAW EDISON

For the full story on these and other Pennsylvania design and construction details, you are invited to contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

PENNSYLVANIA pt TRANSFORMERS

PENNSYLVANIA POWER TRANSFORMERS

Young Named a General Manager at GE

James F. Young has been named general manager-electric utility systems engineering and planning operation at General Electric Co. It is part of the new Electric Utility Group.

Young has been with GE for 23 years, joining the company on the test program. He was supervisor of the creative engineering program for 1939 and 1940, and then served as administrator of the creative engineering, mechanical engineering training and analytical consulting programs until 1944.

After other posts, he was made consultant-energy conversion, Engineering Services Division in 1954. He was appointed general manager of the General Engineering Laboratory in 1958.

PERSONAL BRIEFS

Consolidated Edison Co of New York Inc has made the following organizational changes: **J. Elmer Goodale,** to general manager of station construction and shops; **Charles W. Franklin,** consulting electrical engineer on electrical, rate, system engineering matters; **Frederick C. Shaughnessy,** general manager of outside plant construction; **Gordon R. Milne,** assistant vice president, mechanical engineering; **Dr W. P. Eckes,** assistant vice president, industrial relations and medical; **William C. Beattie,** assistant vice president for production; **Harry W. Dierman,** chief mechanical engineer; **John D. Gray,** director of finance; **Frank A. Going,** assistant auditor; **Richard Fogarty,** assistant manager of the tax department; **Arthur Williams,** manager, Insurance Bureau; **George E. Quinn,** manager of the production department; **Pete Spiller,** associate purchasing agent; **Frederick Van Olinda,** assistant purchasing agent.

Arthur W. Fyte has been named senior assistant general manager, customer accounting; **Michael J. Walsh,** assistant general manager in charge of customer record operations; **Arthur J. Brede,** a manager on the departmental staff in charge of the 705 conversion group; **George H. Pusey,** manager, clerical and control bureau; **Thomas C. Duncan,** chief electrical engineer; **John P. Neubauer,** outside plant engineer in charge of the outside plant bureau; **Frederic N. Cuneo,** distribution engineer in charge of the distribution engineering bureau; **E. C. McCarthy,** general superintendent in charge of the underground bureau; **Alfred W. Fuller,** manager of the SC&S department and **Charles H. O'Neill,** and **Raymond E. Warner,** assistant managers; **Michael J. W. Ryan,** general superintendent of the electrical construction bureau; and **William B. Warner,** general superintendent of mechanical construction and holder maintenance and painting bureaus.

Union Electric Co has appointed **Edward A. Rudulph,** manager of the Taum Sauk "pumped storage" power project; **Paul A. Pickel,** supervising engineer of the project; and **Raymond N. Weldy,** hydraulic engineer. **John F. McLaughlin Jr** has been named superintendent of production engineering, and his post of betterment engineer will be filled by **Kenneth E. Bridegroom.** Pickel's duties as mechanical engineer will be assumed by **Wallace G. Clover.**

Public Service Co of Oklahoma has named **Luther Roberts,** Duncan manager, and **Ray Rice,** Sand Springs manager. **Fred Wildhaber** has been named customer service supervisor, and **Fred Rogers,** dealer sales supervisor.

In an expansion of its midwestern facilities, Ebasco Services Inc has acquired the management consulting firm of H. Ferris White & Associates. **H. Ferris White Jr,** founder and president of the associates, becomes resident director of consulting services for Ebasco's Central Region office. **James B. Hughes,** a former vice president of the White organization, will also be a resident member of the staff, serving as management consultant.

A. J. Turiano has been named president of Spunco Inc. **D. J. Peterman** is the new sales manager.

Harold Freese has been named general manager of Hi Products Inc. The company will expand its line of electrical equipment to include a new line of pole-top hardware and instruments.

Lee B. Thomas has been elected president of Thomas Industries, Inc.

General Electric Co has made the following appointments: **Clement E. Sutton Jr,** manager-sales, special applications; **D. R. Shoults,** representative-atomic development; **Daniel R. Antrim,** sales engineer for the appliance motor department; **Herbert Fishman,** consulting engineer to the transistor advance and design engineering subsection, semiconductor products department; **Albert F. Brun,** manager, replacement lamp sales, miniature lamp department; **Dr John M. Witzel,** manager of engineering, insulating materials department; **Malcolm C. Neuhoff,** manager of marketing, administration and research, meter department; succeeding **S. R. Hess** who goes to the Atlantic District, Apparatus Sales Division; **Gomer F. Davis,** marketing manager, miniature lamp department; **Harold C. Potter,** manager of sales, semiconductor products department.

(*More News About People, p* 130)

A shrieking horn announces the bad news

--POWER UPSET!

In the next few minutes, this man will be too busy putting his station back in service to think about anything else.

While he's restoring service, MOR (F&P Millisecond Operations Recorder) will be busy recording every change in the trouble contact positions on a permanent logsheet. MOR will record the exact sequence and time of events . . . even when they're only milliseconds apart . . . and will do it all automatically.

MOR is designed to monitor from 100 to 400 points and can be connected in parallel with existing annunciator systems.

The low cost of this automatic recorder permits its use in small stations of 75 kw or more . . . as well as in the largest generating stations. The cost is less than that of reconstructing the cause of one major power upset.

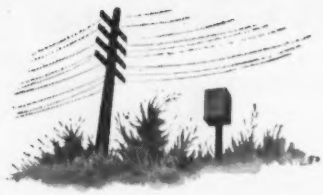
Get all the facts on this low-cost recorder by requesting Catalog 30A1400 from your nearest F&P Sales Engineer. Better yet, ask for a MOR demonstration at your own plant.

Fischer & Porter Company,
5530 County Line Road,
Warminster, Pennsylvania.

FP

These MANUFACTURING AFFILIATES carry Fischer & Porter engineering designs to the far corners of the earth: FISCHER & PORTER (CANADA) LTD., DOWNSVIEW, ONTARIO. • FISCHER & PORTER LTD., WORKINGTON, CUMBERLAND, ENGLAND • FISCHER & PORTER G.m.b.H., GROSSELLERSHAUSEN, BEI GOTTINGEN, GERMANY • FISCHER & PORTER N.V., KOMEETWEG 11, THE HAGUE, NETHERLANDS • FISCHER & PORTER Pty. LTD., 184 HANNA ST., SOUTH MELBOURNE, VICTORIA, AUSTRALIA.

Whatever your brush problem



Line?

Roadside?

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OBITUARY

Morris L. Cooke, 87, a consulting engineer, and the first administrator of the Rural Electrification Administration . . . **E. E. George,** 67, former electrical engineer in the Consulting Engineering Division of Ebasco Services Inc . . . **Gilbert C. Aubrey Sr,** 57, a supervisor at the Philadelphia Electric Co's Transportation Division for 36 years . . . **Charles C. Egbert,** 85, pioneer in the design of hydroelectric power generating facilities, and a consultant for many New York State power companies . . . **Robert E. Foley,** 66, president and treasurer of Robert E. Foley Construction Corp and Foley Electrical Corp which specialize in power line construction . . . **Joseph E. Mickle,** 76, retired manager of the Systems Division, Philadelphia Electric Co . . . **George S. Hewins,** 85, who directed the construction of many of New England's largest dams and power plants, and under whose supervision the Connecticut River was first harnassed for electrical uses.

LETTERS

(*Continued from page 5*)

in rates, if applied on a kwhr basis.

The application of fixed cost changes through an escalator where the adjustment is calculated on a kwhr basis is an attempt to alter the nature of the costs themselves. This can scarcely be done with propriety. Fixed costs don't become variable just because Mr. Vogel says so. One is reminded of Humpty Dumpty's discussion with Alice:

"When I use a word," Humpty Dumpty said, in rather a scornful tone, "it means just what I choose it to mean—neither more nor less."

"The question is," said Alice, "whether you can make words mean so many different things."

"The question is," said Humpty Dumpty, "which is to be master—that's all."

Alice was too much puzzled to say anything. . . ."*

Edwin Fleischmann
Consulting Engineer
San Francisco, Calif.

*Through the Looking Glass and What Alice Found There, by Lewis Carroll, p. 112, The Heritage Illustrated Bookshelf, New York (1941).

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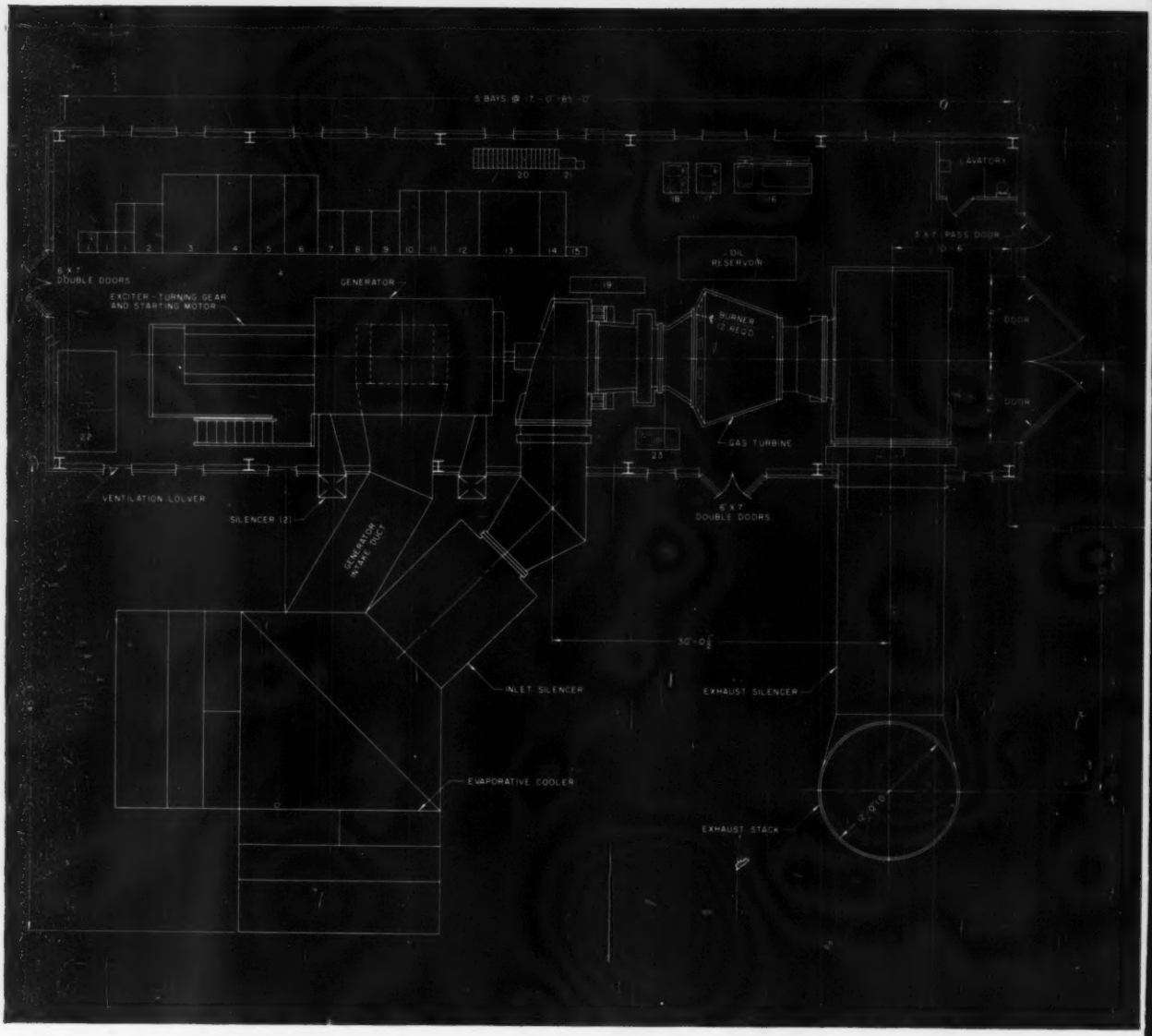
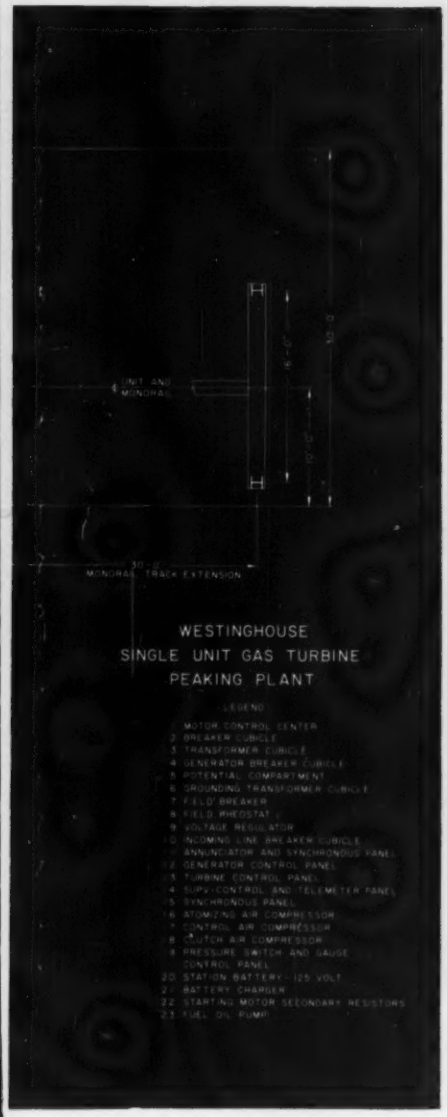
5418-P

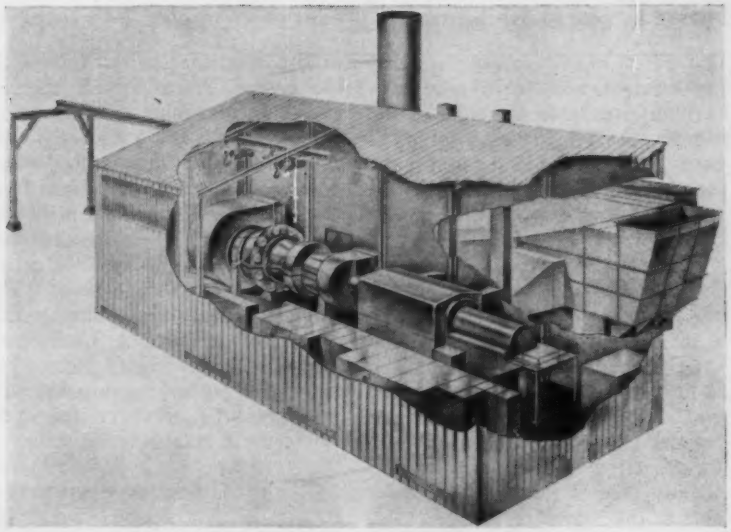


WESTINGHOUSE GAS TURBINES... A NEW DIMENSION IN PEAKING POWER ECONOMICS

MINIMUM COST PEAKING UNITS REDUCE CAPITAL EXPENDITURES, CUT OPERATING COSTS

In order to meet the increasing peak load generation problem of growing utility systems, Westinghouse has developed a complete 22/27.5-mw gas turbine peaking plant. Utilities can save significant capital by installing a minimum-first-cost Westinghouse gas turbine peaking unit, postponing the addition of a large-size base load machine to the system.

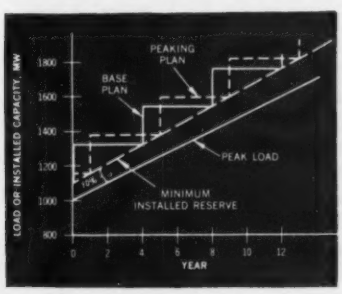




This typical Westinghouse gas turbine peaking plant, shown in layout and in cross section, postpones capital expenditures, lowers operating costs. Westinghouse can supply all equipment for the complete installation, including buildings, with all the advantages to you of single source of supply, and single responsibility.

Typical Capital Savings with a Peaking Unit

A recent Powercasting study for a utility working on a 4-year cycle of adding base load machines showed that the addition of gas turbine peaking plants allowed them to postpone buying base load generating apparatus for an additional year. Economic comparisons showed a potential net capital saving of more than $800,000 over a 13-year period, or better than $200,000 for each cycle. (Graph below left.)



Three Reasons Why Gas Turbine Peaking Units Reduce Operating Costs

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YOU CAN BE SURE...IF IT'S

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Now: Lower Cost Spinning Reserve (*Continued from page 64*)

unit will have an excellent base-load heat rate, equivalent to heat rates currently available for units of the same base-load capacity. It also will have a satisfactory heat rate for the incremental capacity considering the relatively short periods when it will be used.

Operating costs will be close to those required for the base-load operation of the unit, and therefore to a substantial degree, the "spinning reserve" capacity will be obtained at little or no incremental operating cost. It is anticipated that the maintenance costs chargeable to the extra capacity will be equal to or only slightly greater than those chargeable to the base load capacity. But this can be proven only by experience. The "spinning reserve" capacity is almost instantly available, because the unit is in operation and loads can be increased at the normal rates for loading large units.

There are two suggested methods of obtaining the additional short-time steam flow from the boiler and the consequent additional output from the station.

The first method involves increasing the initial steam pressure and decreasing initial and reheat temperature as load is increased past the normal rating.

For example, if the conditions selected as best for base-load operation are 2,400 psig, 1,000/1,000F, the maximum output would be obtained by increasing initial pressure to about 3,200 psig for a 40% capacity increase and lowering temperatures about 50F to hold about the same stress margins in the turbine, superheater, reheater, steam piping and valves. Similarly, an 1,800 psig unit might be increased to about 2,400 psig accompanied by a similar temperature reduction.

Studies indicate that the optimum feedwater temperature for this system can be obtained by removing the two top feedwater heaters from service during maximum load operation. An even higher throttle pressure, throttle flow, and boiler feed pump power would be required to obtain the desired maximum capacity if the heaters were not removed.

Condenser and circulating water systems should be sized for optimum operation at the base-load capacity. If the circulating water flow to the condenser is not increased, the exhaust vacuum will become poorer as maximum turbine capacity is reached. For example, if the condenser and circulating water flow produce 1.5 in. Hg abs at base load, the exhaust pressure might rise to 2.5 to 2.7 in. Hg abs at maximum load. There should be little or no extra condenser cost involved if the exhaust pressure is permitted to rise during demand periods. Under conditions of highly-loaded turbine exhaust, the poorer vacuum has surprisingly little effect on the cycle efficiency at maximum capacity.

All turbine stage pressures and heater shell pressures increase essentially in direct proportion to the flow through the turbine, as do the condensate flow velocities through the heater tubes. Heater design must therefore be carefully considered for the increased shell pressures and water velocities.

Boiler feed pump power requirements will increase as throttle pressure and flow are increased. For a 40% increase in throttle flow and pressure, pump power at maximum capacity is about double that at base load. Most economical means of providing additional power will depend a lot on the design philosophy of the particular utility. If a spare boiler feed pump is normally provided, it can be used during maximum load periods to supply much of the additional power required. An auxiliary turbine drive should be considered for this application because of its flexibility to meet load requirements by varying speed. The same reasoning applies to forced and induced draft fans.

The coal-handling equipment normally is designed to store a full week's supply with operation equivalent to only two or three days a week. It can therefore handle the extra requirements "in its spare time."

The second method of obtaining additional short-time steam flow from the boiler is to bypass a large part of the steam flow from the primary superheater to the reheater inlet, increasing flow to the reheat section of the turbine to achieve the additional kilowatts. For a 40% increase in capacity, flow to the reheater increases about 80%. Bypass flow increases pressures in the reheater and in the reheat section of the turbine about in proportion to the increase in reheater flow.

Initial steam temperature and pressure and reheat temperature may be maintained at normal design conditions insofar as their effect on the turbine is concerned. Temperatures may be reduced if necessary to help distribute surface heat absorption in the various boiler sections.

Studies indicate that to optimize feedwater temperature, with the steam bypass method, it is desirable to keep all feedwater heaters in service at maximum load conditions. But, if boiler design favors removing top heaters from service, the turbine can be designed for this.

Exhaust Pressure Higher

Compared to the increased pressure method, the bypass method will result in slightly higher exhaust pressure for the same increase in capacity. This is because the heat rejection to the condenser is greater. Boiler feed pump power requirements are about the same as for the increased pressure method.

A typical turbine heat rate curve for the two methods of obtaining "spinning reserve" turbine capacity is shown in Fig 3. It is significant, but not shown on the curve, that the heat rate of both methods at the base load point is the same as the base-load heat rate of an equivalent unit without "spinning reserve".

The curve indicates that at the base load point the heat rate is ½ to 1% better than a unit with a ⅓ larger exhaust end, such as would normally be selected at the maximum capacity. At lighter loads this comparison favors the "spinning reserve" unit even more. The maximum capacity heat rate of the bypass method is poorer than the increased pressure method because of inherently greater efficiency of throttling on bypass flow.

A complete appraisal of "spinning reserve" plants is underway. Several utilities are making detailed studies to clarify the investment cost picture. Some of the factors involved are the effect on boiler costs of varying durations of short time ratings; the effect of supplementary gas or oil firing; and the design and use of station auxiliaries. All these factors and others must be considered in comparison with present practices in base load plants.

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APRIL

Sixth Nuclear Congress—New York Coliseum, New York City, April 3-8.

American Institute of Electrical Engineers—Southwest District Meeting, Shamrock-Hilton Hotel, Houston, April 4-6; Conference on Electrical Engineering in Space Technology, Baker Hotel, Dallas, April 11-13; Conference on Electrification of Materials Handling Equipment, Hotel Sheraton, Philadelphia, April 12-13; East Central District Meeting, Charleston, W. Va., April 12-14; Joint Automatic Techniques Conference, Sheraton-Cleveland Hotel, Cleveland, April 18-19; Great Lakes District Meeting, Hotel Pfister, Milwaukee, April 27-29.

Edison Electric Institute—Sales Conference, Edgewater Beach Hotel, Chicago, April 4-6; Power Survey Committee Meeting, EEI, New York City, April 7-8; Industrial Relations Committee joint with New England Regional Utility Group, Somerset Hotel, Boston, April 21-22; Accident Prevention Committee, Desert Ranch and Colonial Inn, St. Petersburg, Fla., April 24-27; EEI-AGA National Conference of Electric & Gas Utility Accountants, Commodore & Roosevelt Hotels, New York City, April 25-27; Statistical Committee, New Orleans, April 28-29.

Northwest Public Power Association—Annual Meeting, Eugene Hotel, Eugene, Ore., April 6-8.

Southeastern Electric Exchange—Engineering & Operation Section Conference, Roosevelt Hotel, New Orleans, April 7-8.

ASME-SAM Management Engineering Conference — Statler Hilton Hotel, New York City, April 7-8.

Pennsylvania Electric Association—Land & Land Rights Committee, Greensburg, April 7-8; Residential Committee, Altoona, April 11-12; Communications Committee, Stanwix Hotel, Johnstown, April 21-22; Systems Operation Committee, Bedford Springs, April 28-29.

Pacific Coast Electrical Association—Administrative Services Section, Huntington-Sheraton Hotel, Pasadena, California, April 11-12.

• **Thirteenth Annual Conference for Protective Relay Engineers**—Department of Electrical Engineering, A&M College of Texas, College Station, April 11-13.

• **Missouri Valley Electric Association**—Engineering Conference, President Hotel & Municipal Auditorium, Kansas City, April 20-22.

• **Electric Council of New England**—Transmission and Distribution Committee, Hotel Northampton, Northampton, Mass., April 21-22.

• **Indiana Electric Association**—Young Men's Utility Conference, Fort Wayne, Ind., April 21-22.

• **Illuminating Engineering Society**—South Central-Southeastern Regional Conference, Peabody Hotel, Memphis, April 21-22; Southwestern Regional Conference, Robert Driscoll Hotel, Corpus Christi, April 25-26; Inter-Mountain Regional Conference, Mountain Shadows Hotel, Scotsdale, Ariz., April 28-29.

• **Rocky Mountain Electrical League**—Annual Spring Conference, Harvest House, Boulder, Colo., April 24-27.

• **American Society of Mechanical Engineers**—Maintenance & Plant Engineering Conference, Chase-Park Plaza Hotel, St. Louis, Mo., April 25-26; Metals Engineering Division-AWS Conference, Biltmore Hotel, Los Angeles, April 25-29.

• **Northwest Electric Light & Power Association**—Engineering & Operations Section, Joint with Personnel & Safety Section, Hotel Florence, Missoula, Mont., April 27-29.

• **Western Air Conditioning, Heating, Ventilating & Refrigeration Exhibit & Conference**—Shrine Exposition Hall, Los Angeles, April 27-30.

MAY

• **National Association of Electrical Distributors**—52nd Annual Convention, Dallas, May 1-4.

• **Electrochemical Society**—Spring Meeting, La Salle Hotel, Chicago, Ill., May 1-5.

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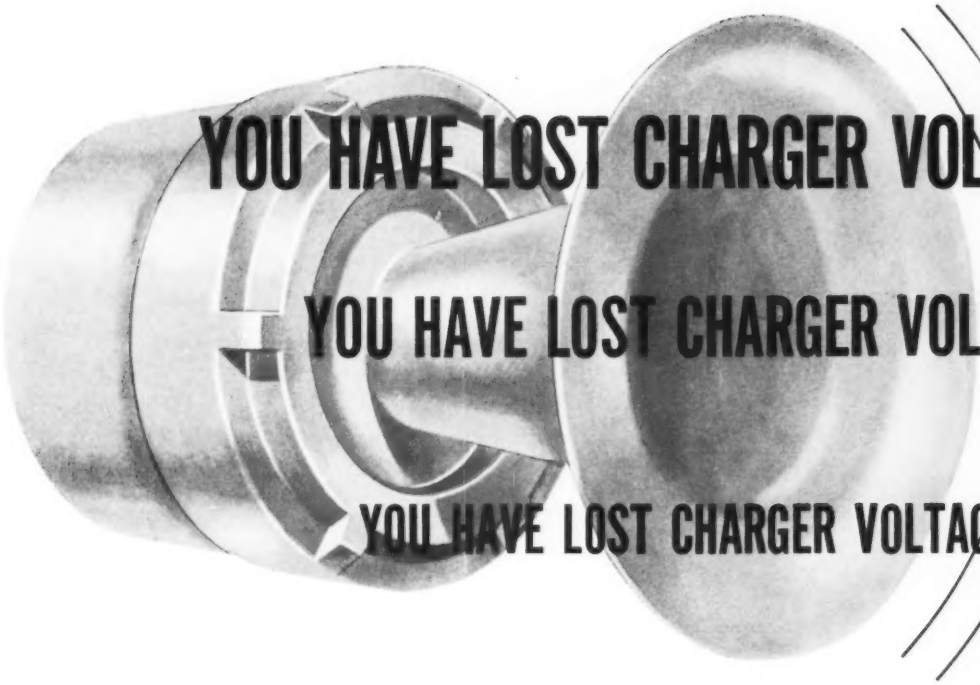

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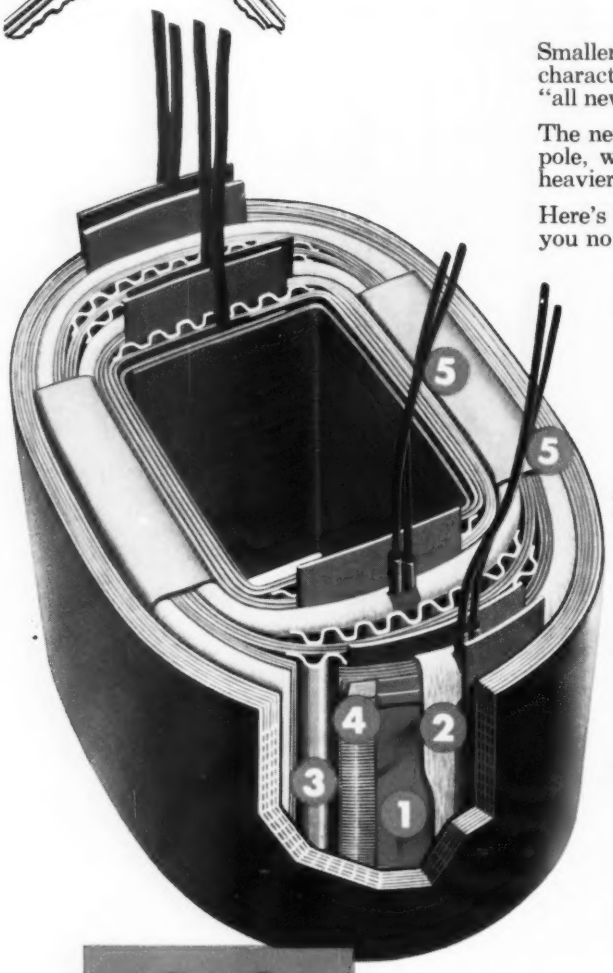

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